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EDITORIAL NOTES—GAS, &c.

Obscurantism in Edinburgh.

THE Edinburgh and Leith Gas Commissioners have been engaged in a contest in Edinburgh fraught with the greatest importance to the gas industry of Scotland; and the result of the contest we believe will set the seal on the future of gas supply there for at any rate the next few years. Pioneer work in the same direction has been done by Glasgow and other towns over the Border; but what the Edinburgh Commissioners have been striving to accomplish is to conform Scotch gas enactment with that which the Legislature has of late adopted for application to English gas supply. What is there in Scotland to-day that makes more suitable for it a different condition of things from that which scientific and parliamentary inquiry has pronounced to be best for England? We confess that we do not know, but, on the contrary, find that all opposition to the proposals that the Edinburgh and Leith Gas Commissioners are now making is purely due to obscurantism, and is subversive of the best interests of the gas consumers. The Edinburgh and Leith Gas Commissioners are applying, in the Provisional Order that has been under consideration, for nothing more, so far as they desire a change in their antiquated obligations, than to be placed under the Model Clauses—that is to say, that their standard of illuminating power should now be 14 candles, tested by the "Metropolitan" No. 2 burner. The Edinburgh Corporation have been the only opponents. As a body, they have shown anything but a united front in the matter; and the obstructives of the body have had no difficulty in getting the old hands, with their equally old story—so often told in the Committee-rooms at Westminster without effect—to come along to render help. It is a peculiar position to find the Edinburgh Corporation in opposition to a body which they themselves were largely instrumental in creating; and we cannot but think that in time to come those who have been chiefly responsible for this antagonism, in face of all that has happened the last few years, will appreciate, as much as others appreciate it now, their own deficiency in enlightenment in 1908. However, having arrayed themselves in opposition, they have had to present some sort of case in the endeavour to justify themselves; and what a weak case it was!

We entirely fail to see that the gas consumers of Edinburgh will suffer one jot from the proposals of the Gas Commissioners, more especially as the latter have, if granted the power sought, no intention of putting their proposals into force at one move, and, as they recede in illuminating power, there is to be a house-to-house visitation to instruct the consumers in the best use of the gas. The case that the Gas Commissioners, through their Engineer (Mr. W. R. Herring) and other eminent gas experts, put before the Parliamentary Commissioners applies not only to Edinburgh and Leith in particular, but to Scotland in general. The Gas Commissioners are not a profit-making body; so the whole of the economies that can be realized through the greater latitude they will, if the Order goes through, obtain in the conduct of their business will be to the advantage of the consumers. The Commissioners will have a greater market before them for the purchase of coal, and will not be restricted as now to the expensive qualities from which gas is produced that is absolutely detrimental to the consumers who are wideawake to the benefit of using modern appliances. But the consumers of Edinburgh are at a disadvantage in connection with these appliances. It so happens that the appliances for illumination are made in England and Germany. In England, for the most part, 14 to 16 candle gas is supplied; in Germany now, with the incandescent burner, there is not much care about illuminating power, and a 12-candle power gas or thereabouts is found good enough for all purposes. The effect is that the high candle power gas of Scotland and the modern lighting appliances made for lower illuminating power gas are incompatibles; and the result of this is that a sufficient quantity of air for admixture with the gas cannot be passed into the atmospheric burners used to obtain perfect combustion. Even though the burners were constructed to permit of the larger admission of air for admixture with the gas, it is a physical impossibility to get such a thorough aëration of a gas heavy in hydrocarbons as is possible with gas of less density in its composition.

The results of this incongruity of gas production in so large a part of Scotland with modern scientific progress are trouble, dissatisfaction, and waste; and these results are what the opponents of the Edinburgh Commissioners wish to perpetuate. They are behind the age. They want the advances of science to adapt themselves to a standstill policy in relation to gas supply; and the advances of science respectfully decline to have any such limitations imposed upon them. The attitude of those of the Edinburgh Corporation who brought about this opposition is, when looked at with unprejudiced eye, and in the light of present-day knowledge, a most ridiculous one. The advances of science in the modes of utilization offer a reduction of expense, a reduction of waste, a reduction of the damage caused by the combustion of a gas heavily laden with what is unnecessary, a widening of the range of application and of useful effect to the user, and the keeping in Edinburgh of a not inconsiderable part of the money that is now paid away for coals that produce something causing these troubles and waste. But a section of the Edinburgh Corporation, blind to progress and economy, would reject all this. Coincidently, their action in opposition to the Commissioners (several of whom are members of the Council) is censorious, exhibits lack of confidence, and reflects upon the Commissioners' honesty of purpose. At the bottom of it all is ignorance.

Subsequent to writing the above comments, and just as the "JOURNAL" was going to press yesterday afternoon, our Edinburgh correspondent telegraphed the gratifying intelligence that the preamble of the Order had been declared proved; so that the Commissioners have succeeded with their case for lower illuminating power gas and the application of modern testing methods. The only gain obtained by the opposition is the right to a testing-place at the City Chambers in Edinburgh, and one is also to be established at the Municipal Buildings in Leith; and these are to be regarded as testing-places under the Gas Acts. It is more important to the Gas Commissioners and to the consumers that there should have been success on the illuminating power question, and loss on this one as to new testing-places, than that the authorization to a lowering of the illuminating power should have been lost, and the Corporation defeated on the claim to an in-town testing-station. The intelligence is gratifying, though we cannot see that the Parliamentary Commissioners could have come to any other decision without deliberately flouting recent parliamentary procedure. It will be an excellent thing for the whole of Scotland that the Gas Commissioners have scored this success in breaking through archaic custom; and we may express the hope that the day will not be far distant when the experience of Edinburgh will convict as erroneous and imaginary the ill-bodings of the opposition of to-day, as experience has already disproved the similar predictions made in regard to London and other places.

The Feld System of Purification and the New Centrifugal Washer.

CARBONIZATION has been occupying a very large share of thought and attention of late; and we appear to be on the verge of a considerable change in methods and results. There is a recognized opportuneness in this, when consideration is given to the trend of legislation—a trend that has been brought about (though not without hard labour

and pertinacity) by the aid of scientific developments in application. It would be a curious thing if, under these circumstances, we should almost concurrently have unfolded to view a new and practicable system whereby the whole of our old purification processes and methods were transformed —a system prepared on definite lines for definite ends, and incorporating the agency of liquids and temperatures graduated according to the tension and the pressure of the constituents that it is desired and desirable to remove from the crude gas. This is the fascinating process some of the features of which (apart from patent specification publication) Herr Feld partially confided to a few highly interested gas engineers from various places who met him yesterday week in Manchester.

It is a big and ambitious scheme, the development of which is being prosecuted with confidence on the side of the inventor, and with admiration and the best wishes for success on the part of all gas engineers who have made a study of his proposals. Herr Feld is a physicist and a chemist, and furthermore he is an enthusiast; but until his scheme is brought to a more concrete form and to a practical scale of working, there will naturally be some reticence on the part of the actual workers of the gas industry to express an unqualified faith in the system as an applicable and workable one both in its designed effects and commercially. There is something, however, very attractive in the idea of being able to extract from the gas the tar, the different grades of tar oils, the ammonia, cyanogen and the sulphurretted hydrogen separately in a process having throughout common fundamental principles; of being able to recover the first-named products free from sulphur; and, moreover, all bye-liquids obtainable in the process of gas manufacture—the process also carrying with it the abolition of all present purifying and condensing plant. The idea has a somewhat staggering effect on those who have been following a limited practice in purification on the traditional lines, though improved by time and experience; and therefore Herr Feld must not be surprised if gas engineers do not accept his propositions and plans without some little suspicion as to the feasibility of overthrowing at one stroke the practices established by time. It is too much for the imagination to immediately grasp, and too great a strain on belief. But let the inventor not be disheartened. He has introduced his system to a sympathetic audience—an audience that will follow his work with awakened interest to its end, whatever that end may be; and if it is successful, that same sympathetic audience will be only too eager to welcome the system, where working is on a sufficiently large scale for its profitable application.

In the course of his work, Herr Feld has constructed a washer for the purpose of carrying out the system; and that washer bids fair, so far as can be gathered from expressed views on first investigation, to gain a rapid popularity for the ordinary purpose of washing crude gas. It is a centrifugal washer of vertical form, in the several chambers of which the gas is successively subjected to rigorous washing without the aid of packed drums. The staid motion of the washer-scrubbers as we have known them hitherto is not found in this new form of washer. The central shaft makes revolution no less than 120 times in a minute; and, by means of an ingenious arrangement of cones, water is picked up from the container in each chamber, and is thrown off continuously in the form of a thick spray. Through this spray the gas passes in its upward travel through the chambers; and it is clear there is no possible chance of the gas escaping without being effectually treated. There is no opportunity for anything to settle in the apparatus; and it can be deduced from this that the washer is self-cleansing. The wear and tear too cannot be great, though the rapid revolution of the shaft has suggested to more than one investigator that there may be some difficulty in this respect. The inventor has foreseen this objection; and the shaft runs in ball-bearings at the top. Touching this point, too, is the small amount of driving power required. The principle of the arrangement, the operation, and the effects of that operation have, as we have already said, taken the fancy of several gas engineers; and as to the efficiency——well, the inventor has, from experience gathered on the Continent, a large measure of assurance of the fullest satisfaction in this regard. Supplementary to what is stated here is additional information in the sketch in this issue of the meeting with Herr Feld, and of the inspection of the first washer constructed in this country, to which meeting and inspection reference is made in the opening paragraph.

Technical Matters at the North British Meeting.

TECHNICALLY reviewed, the proceedings at the North British Association meeting last week were of more than ordinary value, if only on account of the two papers on high-pressure gas distribution in comparatively small districts that were before the members. Consideration, however, of the eminently practical address of the President (Mr. W. Blair, of Helensburgh) also affords ground for some reflection. The address was short; but it gave the plain unvarnished beliefs of an observant gas engineer and manager. The President applies the fruits of his personal observation to the shaping of his professional opinions; and, given opportunities for such salutary exercises, there should be a rapid knocking over of one fetish of a large part of the Scottish gas profession that has for its supporting base nothing more stable than tradition. Mr. Blair went to Berlin, and saw the Dessau vertical retorts at work; he has also studied the results of the working of the Woodall-Duckham system, and Mr. Love's 45° inclined retorts; and he looks hopefully, as a faithful gas engineer in Scotland should, to the ultimate success of the Young and Glover system. But while in Berlin, the President did not confine attention to the working of the Dessau retorts. He saw that, under the system of working, the illuminating power of the gas distributed is low, but the calorific power is good; and taking the gas supplied in the capital city of Germany, he finds that, with a low and uniform illuminating power of something like 12 candles, and a heating value of approximately 550 B.Th.U., "all the requirements "of the gas consumers are thoroughly well satisfied." Anyone, he further remarks, who has seen the magnificent street lighting by gas in Berlin will admit at once that high candle power is not everything. "I have seen nothing to beat it" he emphatically adds, referring to the street lighting. This special prominence is given to this part of the address because it is a healthy sign to see a gas engineer of Scotland in charge of an undertaking with a prescribed illuminating power standard of 14 candles and supplying according to the returns above 20 candles, ranking himself in his belief on this head with the engineers of some of the premier gas undertakings in Scotland. If the local councillors and the gas engineers could all be taken over to Berlin, and there exercised the same degree of observation as Mr. Blair did on his recent visit, the days of their rich and heavy gas—so heavy that not so good an effect can be obtained with it in the bunsen burner, nor such a useful amount of power be realized from its use in the cylinder of a gas-engine, as with a lower-grade gas—would be numbered with greater alacrity than they are being at the present time. It was somewhat of a coincidence that the President of the Association should have been declaring his views on this subject in Scotland at the very time the Edinburgh and Leith Gas Commissioners were fighting in the city to secure the ousting of an ordinance that scientific progress has caused to be effete.

The President also had a few commonsense observations to make from his own experience on higher gas pressures in his distribution area. Mr. Blair has not gone so far yet in his work in this direction as Mr. J. D. Keillor, of Lochgelly, or Mr. Alex. Waddell of Dunfermline; but he, some time since, came to the conclusion that the alternative, in the near future, to incurring a considerable expenditure on his distribution system would be to place reliance on some auxiliary boosting means. Recourse to higher pressures in distribution work and the enjoyment of their utilitarian and economizing attributes, are not the exclusive privileges of the larger gas undertakings; they are just as open to the smaller concerns, and, in fact, in places even more so. With the complicated systems of mains of the large undertakings supplying in densely populated areas, with the great diversity of pipe diameters, connections, and purposes, the problems of general distribution at fairly uniform higher pressures are much more complex than in a district with comparatively simple canalization. Both Mr. Keillor and Mr. Waddell show how high-pressure distribution has enabled them to save expense, and to give a satisfactory supply in the districts with which they have had to deal. It is, however, difficult to form any precise judgment as to the schemes and their working being the most suitable for the particular circumstances without something more than a mere paper acquaintance with the facts so far as they are presented, and without complete possession of information which is necessary for a calculated determination. There is much more requisite for this purpose than the mere knowledge regarding the diameter of pipes and their length. Gradients,

bends, the specific gravity of the gas, and many other deranging factors all come in to upset any specific or comparative judgment of methods and pressures adopted by different engineers for their special purposes. But when two engineers find their practices in connection with high-pressure giving their consumers complete satisfaction, and, from their own point of view as purveyors, they find in those practices economy, then it must be accepted that each is doing his best under his own set of circumstances. Satisfaction and economy are found in these two papers.

The high initial pressure up to which Mr. Waddell works in his practice to supply certain districts (20 lbs.), will be remarked with some curiosity; but it will be also noted that these districts are at a distance and some 144 feet below the level of the gas-works. This question of initial pressure has relation to the method of governing adopted; and Mr. Waddell introduces us to a considerable extension of an old application of automatically regulating the means of governing by a pressure return-pipe. Mr. Keillor follows the ordinary practice of district governors; but Mr. Waddell has struck out on a more independent line, by running through his high-pressure main a $\frac{3}{8}$-inch block-tin pipe, to communicate the pressure existing 3 miles distant to the compressor at the works, and in this way to regulate the compressor steam-valve, and thus govern the initial pressure to the requirements in the out-district. It seems to have answered its purpose so far; but we have doubts as to whether continued experience will prove its reliability as a means of regulation. Reliance is placed here on a $\frac{3}{8}$-inch bore pipe, 3 miles long, with a difference in level of 144 feet between the supply district and the compressor, supplemented by such disturbing factors as variations in the specific gravity of the gas, condensation, friction, and so forth. Under such conditions, there must be a fairly considerable lag in the transmission of the variations of pressure; and, therefore, that any perpetual reliable indication of the conditions existing 3 miles away will be produced under such circumstances at the compressor, to ensure the necessary initial pressure to maintain an approximately equal pressure at the distant parts of the supply area, we are not yet satisfied will be realized. However, this is only one of many interesting features of these two papers, the details of which there is no necessity to refer to here, as their publication, with the discussions, next week will give our readers all the available information.

The only other paper that was read at the meeting was by Mr. R. W. Cowie, of Lockerbie; and it was entitled the "Financial Difficulties of a Small Municipal Gas-Works." It might also have been entitled "The Vindication of the "Application of Progressive Methods in Small Gas-Works." The local authority of Lockerbie some seventeen years ago thought they could run the gas-works with greater ability than the then possessing Company, and with greater financial advantage to the people of the town. In their day the local authority suffered from the inordinate conceit that has brought upon modern local government pretty generally a character for shameless financial profligacy; and the consequence was that, as in many other quarters now, the ratepayers and the gas consumers of Lockerbie for a generation suffered. Lockerbie reflected seventeen years ago and since that beautiful indifference which flourishes elsewhere to-day to the distinctly varied obligations that rest upon men who trade on capital furnished by themselves and at their own risk, and upon men who borrow money for similar purpose. That indifference cost the Lockerbie gas consumers and the ratepayers money; and incapacity to find sufficient profit from the trading to cover responsibilities resulted in the works remaining for a long period in a state of abject exhaustion. Mr. Cowie is all modesty in his paper. He tells a plain tale of what has been done, without allocating any portion of the credit to himself. The price of gas has been greatly reduced, the financial difficulties have ceased to exist, the works are up to the best of modern condition for works of the size, they are capable of meeting requirements for many a day, and the capital to-day averages £952 per million, against £2371 fourteen years ago. The drifting to a worse condition has been completely stemmed, and a progressive policy animates the Gas Committee. They are trying to make their little undertaking a model, and not a reproach. Their success so far should encourage them to persevere in well-doing. There is in the paper a reminder of the well-known case of *Milne v. Commissioners of Lockerbie*, heard in 1894, which judicially interpreted, on appeal, the intention of section 41 of the Burghs Gas Supply Act of 1876 to be to give gas commissioners the right to consider whether, in fixing the price of gas, a higher or a lower rate of charge will yield the greater income for meeting liabilities. In considering the contents of this paper by Mr. Cowie, it must be remembered that the gas industry is composed of more small works than those that can be described as large ones; and to the administrators of the majority, the contained lessons should be valuable.

Workmen's Compensation Law.

One or two somewhat novel aspects of the law as regards workmen's compensation have been revealed recently in different Courts. In one instance the scene was a Police Court, where a workman was charged with perjury, committed in support of a claim for compensation in respect of injuries caused by an accident which it was alleged had in reality never occurred. In another case, before the Judge at the Taunton County Court, the question was argued as to whether the widow of a man engaged (as reported in the "JOURNAL" at the time) at an electric lighting station where a gas-producer was in operation could obtain compensation in consequence of her husband's death, as alleged, from poisoning by carbon monoxide, which accumulated gradually in his system by inhalation extending over a long period. The employers submitted that death had not been occasioned by any disease scheduled under the Statute. The doctor could not fix any date on which deceased was poisoned; and carbon monoxide was not mentioned in the schedule. Ultimately, the Judge said he feared he must decide against the widow; but it was then claimed on her behalf that carbon monoxide might be classed with carbon bisulphide, which was scheduled, and it was arranged to secure technical opinion on the point. In the event of this being to the effect that carbon monoxide did not come within the schedule, the plaintiff agreed to accept the Judge's decision against her. The remaining case to which attention may be directed was before the Court of Appeal last week, and was an appeal by a workman from an award of the Marylebone County Court Judge. The applicant contracted enteritis by inhaling sewer gas while working in one of the London County Council's sewers; and this, by accelerating long-standing heart disease, incapacitated him. The Judge held that the contracting of enteritis in this way was not an injury by accident within the meaning of the Act. He also held that it was an incident of the man's work to encounter noxious gases in the atmosphere, so that the event could not be said to be unexpected, but was a thing which might happen to anyone engaged in such work. Without calling upon the respondents, the Court dismissed the appeal. The Master of the Rolls pointed out that it was not enough to say the injury was caused by the employment, but there must be the further element of accident. What the applicant suffered from was not one of the diseases mentioned in the schedule to the 1906 Act, which provided compensation for certain trade diseases as if they were injury by accident arising out of the employment.

Politics in Local Government.

The opinion has often been expressed that the administration of the affairs of local governing bodies on Party lines is a mistake; and people who hold this view are not likely to gather any reasons for changing it through reading the reports of a libel and conspiracy case which was tried at the Liverpool Assizes a few days ago, and the parties to which were members of the City Council. Judging from the proceedings, the events which led up to the action arose to some extent at least out of Party considerations; and such a condition of "strained relations" as they led up to cannot possibly have been to the benefit of the city at large. The plaintiff, Alderman Fred Smith, a well-known Liverpool Solicitor, and Deputy-Chairman of the Tramway and Electric Power Committee, alleged that three other members of the Corporation—Councillors Skelton, Stoddart, and Gates—conspired to oust him from the deputy-leadership of the Liberal Party, which position he lost a few months ago; while the libel complained of was that the plaintiff had had made by a Corporation servant, in Corporation time, and of Corporation material, a water-motor, which in reality was a toy presented to his little boy by an employee at the electric power station. The answer was a denial of both conspiracy and libel; but it was submitted

that if the statement complained of was published, it was on a privileged occasion, and was a matter of fair comment. The defendants also sought to show that Alderman Smith was deposed from his position as deputy-leader of the Party "in consequence of his insolence to his leader, Sir William Bowring, and other members of the Liberal Party, to which defendants also belonged. Plaintiff, who has been connected with the Electricity Department since 1894, urged that an undertaking of this character—a business undertaking to be worked for the benefit of the citizens of Liverpool—ought to be conducted on business lines, and to be removed entirely from the "sport of Party politics;" and the charge he made against the defendants was that, in view of their differing from his attitude upon the question of the non-political administration of the department, they, following up private grievances, attacked him unitedly, and drove him from his position as deputy-leader. The presentation of the plaintiff's evidence extended over three days; and this stage having been reached, the Jury asked leave to retire, and on returning into Court after a short absence expressed the opinion that plaintiff had failed to make out his case. Into the whole circumstances of the action, or the private grievances which the defendants were said to have harboured against Alderman Smith, it is not necessary to enter. The personal disagreements may or may not alone have been sufficient to give rise to the trouble that led up to the legal proceedings; but it is evident that political considerations had a lot to do with the matter. Though, on broad lines, it may be necessary to have two Parties in a council—be they called Liberals and Conservatives, or by any other names—it is to be hoped that Party considerations are not allowed to influence individual judgment. One cannot, however, altogether banish the feeling, after reading through the reports of the action here referred to, that at Liverpool, as at many other places, political considerations are sometimes permitted to take a somewhat more prominent place in the business of the City Council than is at all necessary for the proper administration of local affairs. Looking at the general question, what ratepayers want on their councils are the men who are best able to judge of the local requirements, and to find means of carrying them out; and what councils need on their committees, are men who are best acquainted with the particular business which the committees have to transact—to whatever Party they may happen to belong.

NOTES FROM WESTMINSTER.

The Potteries Federation and Other Matters of Interest.

The Bill to confirm the Local Government Board Order which proposes the federation of Burslem, Hanley, Longton, and Stoke-upon-Trent, and the urban districts of Fenton and Tunstall, has passed the Select Committee of the House of Commons. Federation, if the Bill goes through, will amalgamate the whole of the districts into one borough under the designation of Stoke-on-Trent. There is a great deal to be said in favour of this federation from the point of view of the commonweal; but many interests are involved, and no scheme should go through until the whole are adequately considered and protected. The scheme entails the acquisition by the proposed new borough of the gas undertakings that are to-day separate municipal possessions—that is to say, those of Longton, Burslem, Stoke, and Fenton. Hanley and Tunstall, being supplied by the British Gaslight Company, are not affected in this respect. There are several details involved in this big scheme over which it is useless to go apart from the report of the proceedings in our "Parliamentary Intelligence." The whole matter has purely local concern; and it is not likely that a similar set of conditions will ever be reproduced, and claim the treatment that is now necessary to effect the consolidation of the local government of the Potteries. But the scheme is not through yet; it has still to go before the House of Lords. It is, however, very unlikely that a federation that most people in the area agree will be advantageous will be defeated on details that are essentially secondary, though having, viewed from the standpoints of the individual districts and other involved interests, for them an importance. The Bill, as mentioned, has passed the Committee of the Commons, but with certain valuable conditions attached. A Valuation Committee it has been decided shall be appointed, the constitution of which is to be in accordance with terms set forth in our parliamentary news. This plan is much preferable to the idea of the Borough Surveyors acting as the valuers, as contemplated in the Order. The Valuation Committee should result in an equitable adjustment of any feared grievance. The Committee have also determined that when the gas or electricity undertakings reach a profit of 5 per cent., all receipts beyond shall go in reduction of the price of gas to the consumer. We prefer the limitation to absolute freedom in this matter of profit-making. But, inasmuch as the consumers have to pay all the capital and other charges appertaining to the undertakings, we should have liked to see it enacted that all excess profits, after providing necessary funds, should be applied to the reduction of the gas charges, and such calls (if any) made upon the rates reimbursed when the profits allowed.

In regard to the Port of London Bill, the Gas Companies concerned have pursued their opposition in defence of their interests; but there has been nothing in the nature of a specific gain to record yet. Again in the past week a Committee of the Commons—this time one presided over by Mr. C. N. Nicholson—have shown a want of sympathy with a modern proposal of municipal authorities controlling both gas and electricity undertakings, to be empowered to cut off both supplies in the case of a consumer being in arrear with his payments for one. In the case of the Burnley Corporation Bill, the power was not allowed; and now the Keighley Corporation have also been unsuccessful—the Committee failing to see why because a man is in arrear with his payments for one commodity, he should be deprived of another for which he is not in arrear. There is clear argument on both sides of this question; but the old-fashioned practice of permitting every tub to stand on its own bottom is still a good one. The Unopposed Bills Committee have been considering the measure providing for a Gas Board for Wath-upon-Dearne and Bolton-on-Dearne; the undertaking which is to pass into the hands of the Board being that of the Wath-upon-Dearne Gas Company. The Committee have consented to the term of forty years for the repayment of the purchase money; but this must not be taken as a precedent. Financial matters are being looked into very keenly now by the Government Departments in connection with Private Bills and Orders; and, in this case, it has been found that a considerable part of the purchase money will be represented by quite recent capital expenditure. Hence the forty years. Every case has to be judged on its own merits. The same Committee have had several Gas Provisional Orders before them through Unopposed Confirmation Bills. Gas Companies who desire to bring their testing arrangements up to date should note that the East Hull Company are getting through with their Order having for its object this piece of modernizing. In the Order of the Caldicott and District Gas Company, the promoters had not limited their dividends; they have been limited now in accordance with the usual practice. The proposal of the Earby and Thornton Gas Company to issue 6 per cent. preference shares has not been allowed; 5 per cent. being considered sufficient. The renewals fund has been deleted from the Tenterden and District Company's Order on the ground that it is a maximum price concern. It is interesting to observe that the Board of Trade are looking very searchingly into the Provisional Orders that now come before them; and when new Companies ask for powers, there are indications that the Board intend to exercise a closer supervision over subsequent dealings with the Orders. We hope the Board will take the same course as they have lately done in the case of Electric Lighting Orders, and not permit them to be looked upon by the promoters as marketable commodities and a means for enriching Company mongers. Parliament has been making itself a tool of the professional Company promoter very much of late, and not to the public advantage. It is not pleasant to see Parliament and the powers it confers dragged through City mire.

The Holderness Water Company's Bill has made a rapid transit from the House of Commons to the House of Lords, and has already been disposed of by a Committee of the latter. This is not surprising. The only opponents were the Withernsea District Council, who did not want the services in their area of the Company. But the Council were just as unsuccessful in the Upper House as in the lower one in showing that their action was supported by wisdom; and their Lordships marked their sense of disapproval with the Council's case by relieving Counsel for the promoters of the necessity for reply. The Ammanford Water Bill, which was recently going through the House of Lords, has been making progress through the Commons, and has been approved, after a contest, by a Select Committee. The opposition was mainly conducted by the Glamorgan and Carmarthen County Councils; but the Llandilofawr District Council and Mr. W. N. Jones, a local property owner, were also hostile. Excepting the Carmarthen County Council and the riparian owner, the promoters came to a peaceful agreement with the opponents—among other things, consenting to a limitation of appropriation to 450,000 gallons a day. The Carmarthen County Council were only present having an eye to the future, and to a later promotion by themselves of a comprehensive scheme to obviate difficulty in the water supply of the small towns of the county in the future. They might just as well have saved themselves the trouble and expense of coming to Westminster; for, if the Irishism may be allowed, their gain was *nil*. There were alterations in details of the Bill, but nothing more; and it will now go forward to the ultimate stages.

Mr. H. James Yates, the Managing Director of Messrs. John Wright and Co., has been elected a Fellow of the Chemical Society. Those who are best acquainted with the research work which Mr. Yates has carried on for a number of years in connection with the chemistry of combustion and radiation, will recognize the appropriateness of the honour which has fallen to him.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 272.)

THE general position on the Stock Exchange, so far from achieving any recovery last week, went rather from bad to worse. The centre of depression was Consols (our space does not permit discussion of the causes); and their far-reaching influence powerfully affected other markets. But the Railway Market had its own troubles into the bargain. After being cheered up by a favourable dividend announcement, a succession of adverse ones dashed it down into deep depression. A stronger American Market had little or no staying power; and the week closed very flat. To journalize movements: The opening was dull on Monday, and all markets, except the American, gave way. Tuesday was generally depressed; but just before the close there appeared promise of amendment. This died away on Wednesday, and fears regarding home and foreign politics sent Consols down nearly ½. Thursday was better; for prices were not uniformly lower. Consols mended a fraction, and Americans imparted a ray of cheerfulness. But Friday undid all this; and weakness and sensitiveness were the general characteristics. Saturday could effect no recovery, and flatness was the rule. In the week, Consols lost $1\frac{3}{16}$—a heavy fall. In the Money Market, there was an ample supply to meet all short requirements at unchanged rates. The tendency in discount was to greater firmness. Business in the Gas Market was pretty brisk, though perhaps scarcely as active as the week before. A favourable impression was created by the announcement that the Gaslight and Coke Company would pay an increased rate of dividend and still carry forward a largely augmented balance. Adding to this balance the cost of the higher dividend and the cost of the difference between the reduced price of gas and the resumed meter-rents, the total improvement looks like something not far short of £100,000. The quotation rose a point, with dealings at from $98\frac{1}{8}$ to $99\frac{1}{2}$. In the secured issues, the preference made 108 and $108\frac{1}{4}$, and the debenture from $83\frac{1}{2}$ to 85. South Metropolitan also rose 1, with dealings at from 119 to $120\frac{1}{2}$. The debenture was done at $84\frac{1}{8}$ and $84\frac{3}{4}$. Commercials were firm at from $108\frac{1}{2}$ to $109\frac{1}{2}$ for the 4 per cent., 103 for the $3\frac{1}{2}$ per cent., and $81\frac{3}{4}$ and $82\frac{1}{8}$ for the debenture. In the Suburban and Provincial group, Bournemouth "B" marked $16\frac{5}{8}$ and $16\frac{1}{4}$, British from $41\frac{1}{2}$ to $42\frac{3}{8}$, Brentford old $245\frac{1}{2}$ and 246, ditto new 183 and 184, Hastings $94\frac{1}{2}$ and 95, Lea Bridge 115, South Suburban $117\frac{1}{4}$, and West Ham 102. In the Continental Companies, Imperial changed hands at from $179\frac{1}{2}$ to 182, Union at 112, ditto preference at 138, European fully-paid at from $22\frac{5}{8}$ to $22\frac{7}{8}$, and ditto part-paid at 17. Among the undertakings of the remoter world, Bombay new marked 4 and $4\frac{1}{4}$, Buenos Ayres $11\frac{3}{8}$, Cape Town debenture $79\frac{3}{8}$ and 80, Monte Video $11\frac{5}{8}$ and $11\frac{11}{16}$, Primitiva $6\frac{1}{8}$ and $6\frac{3}{16}$, ditto preference $5\frac{1}{8}$ and $5\frac{3}{32}$, ditto debenture $93\frac{3}{8}$ and $93\frac{1}{2}$, River Plate from $13\frac{5}{16}$ to $13\frac{7}{16}$, and San Paulo debenture $50\frac{1}{2}$ and $50\frac{3}{4}$.

ELECTRICITY SUPPLY MEMORANDA.

Loss at Hastings—Fallacies—Units at Fuel Cost—A Deadlock and a Dead Loss at West Ham—Municipal Doubts and Regrets—Perpetual Confidence of Power Company Directors—Fusion and Cable Fumes or Coal Gas.

WE said the other week that, apparently, the Hastings Town Council rushed through their ruthless resolution regarding the conversion of a number of street lamps from gas to electricity deliberately before the publication of their annual accounts, and suggested that this haste might be due to anxiety to allow the proposed action to escape the criticism of the ratepayers before the results of last year's administration of the electricity undertaking were known. The suggestion has a more substantial base than was suspected. Those who were responsible for rushing the public lighting resolution through the Council must have been well aware of the ill-conditioned financial statement that would before many days have to be placed before the ratepayers. The net result of last year's working of the undertaking is a deficiency of only a few pounds short of £3000. The gross profit has receded by nearly £2600, though the total expenditure was only about £600 more. The private consumption has declined by 42,662 units. Some of the councillors are looking into the accounts for redeeming features; they look in vain. All they can find is the financial wreckage of the Committee's administration. The flame arc lamp and the metallic filament lamp were going to revolutionize things not long ago in Hastings; and the trading of the concern was going to be so much more profitable. A brake has been put on the "revolutionizing" process; and the profits of the concern are again showing their inability, by £3000, to meet the obligations of the department. There is, if we mistake not, worse still before the undertaking. The Committee appear to be doing their best, in ignorance, to bring the electricity concern to a worse state. Estimates and anticipations with them do not materialize. There was that little Clive Vale extension not long since, which involved an outlay of £1507. It was said that eighteen householders in the new district to be opened up had pledged themselves to become customers. That was anticipation; the realization is four customers, and the revenue from them to June 30 last £12 12s. 4d.! It is asserted in the Council that the expense of converting street-lamps from gas to electricity has exceeded the estimates. There is another proposal now to convert 480 further street gas-lamps to electricity at a capital cost of £1683, and to give only 45-candle lamps for about £3 11s. 6d. each per annum—including lighting, cleaning, extinguishing, renewals of lamps, and electricity consumed in 4080 hours—but the figure does not include any capital charges.

The Electrical Engineer states that he has reckoned the charge for this extra street lighting at 2d. per unit. But the average cost per unit of electricity sold last year, including the capital charges, was 5·88d.; but exclusive of capital charges, 2·61d. The cost of generation only works out to 1·64d.; and for the fuel (which forms part of the 1·64d.) the cost was 0·93d. "Fuel is," says the Electrical Engineer, "the only additional expense which would be incurred in supplying the proposed lamps with current." If it were not impolite, we should like to give a terse and flat denial to this statement. The figures of the Electrical Engineer and the deficiency in income show that the average price already is not sufficient to cover the financial obligations of the department. Bear in mind that the average cost of electricity sold last year, inclusive of capital charges, was 5·88d. per unit, and this was with a sale of 821,671 units. On top of this, he is going to place 117,600 units a year—the consumption of the 480 lamps—at 2d. per unit. That is to say, he is going to raise the sale by one-seventh, and reduce the average income per unit which was (without the additional low-priced electricity) insufficient to meet the financial needs of the department. The only extra expense that will be incurred for this addition of one-seventh to last year's total sale Mr. Ferguson says (notwithstanding that it comes on the peak of the load) is for fuel. How many more 117,600 unit volumes can Mr. Ferguson supply at the mere cost of fuel? This will not do. The days of miracles are past; and Mr. Ferguson, if he had concentrated in him all the subtlety of the electrical profession, could not work such a miracle as, before the Council, he professes to be within his power. He may have spare plant at the present time; that plant cannot be used without incurring some expense beyond that for fuel. Business may expand, and new plant may be required, and all the quicker because of this additional public lighting load. However, we shall hear more about this matter when—and more especially if Mr. Hooper investigates the application—the Inspector of the Local Government Board goes down to Hastings to inquire into the reasons for incurring an expense, without gaining some advantage, of £1683. While the Inspector is in Hastings, he might, if his duty will allow him to do so, examine certain members of the Electricity Committee who profess to be quite learned in load factors and so forth, and particularly the one who asserts that Hastings can produce electricity for ½d. per unit for public lighting. However, this is the kind of belief that does not assist the concern to a sounder financial condition. Members of the Committee unwittingly pose before those who know something of these matters as splendid specimens of credulity; and meantime the undertaking suffers.

The West Ham Electricity Department is under scrutiny by Mr. H. R. Hooper, in connection with a proposed loan of £51,600 for which application has been made. The department are going through the ordeal very badly. Loans have been overspent in the aggregate by some thousands of pounds; and the Inspector naturally is anything but pleased. Among the things said by the way during the inquiry so far as it has gone by Mr. Hooper, are these: "It seems to me that the concern has been running for some time without making any profit at all; and the position is somewhat serious with regard to capital expenditure." Again, and this is a remark the Hastings councillors should consider: "There has been an enormous increase in the number of units sold [5 millions increase], and yet the revenue has not risen in proportion to meet the extra expenses of working." The Inspector has also found that charges have been made to capital that, in his opinion, should have gone to revenue; that altogether the undertaking has been responsible for a charge to the rates of £25,000; that there is no reserve fund; that, in consequence, the ratepayers have a right to know something about the terms of contracts for electricity that have been entered into by the department (it is suspected) outside the advertised tariff, but that the Corporation representatives positively decline to divulge to him or anybody else matters that are the subject of contract. The result is a deadlock in the inquiry, which the Inspector has now adjourned *sine die* in order to report to the Local Government Board that the Town Council will not give him necessary information. We are interested in West Ham. Like many others, we have had our attention arrested by the raucous blare of the trumpets used in that quarter. One of the results of the noise is a loss of £4600 on last year's working. West Ham coal bunkers and literature announce in big letters that "electricity is cheaper than gas;" but ratepayers of West Ham must have grave doubts as they look at the losses whether electricity cannot be too cheap for those who are not consumers.

Spasmodically, some members of municipal councils with unfortunate electricity concerns get the blues over the waywardness of affairs generally; and then they want to shift from their shoulders the burden of these concerns from which they expected great things—not of the nature of great trouble. Quite recently the Progressives of the Southwark Borough Council were no doubt startled to find a notice of motion on the *agenda*, having for its purpose the appointment of a Committee "to inquire and report to the Council on what terms the electrical undertaking

of the borough can be sold or leased, having due regard to the interests of the ratepayers of Southwark, the consumers, and the employees." The motion has stood on the *agenda* for some time; and it was to have been discussed last Wednesday. But up to the present we have not heard the result. The Sunderland town councillors are also bemoaning the situation of their Electricity Department. Although the sale of electricity increased in the past year by 1,067,006 units, it is pretty clear that, as the power consumers took 1,130,650 units, there must have been a loss in the sale in more profitable directions. However that may be, the debit balance on the year's working is £1908. Result, an opinion that it is high time the Council did something in connection with the department. Of course, they have been doing "something" for years past; but it is a question whether there has not been some flaw in policy. There is a motion in abeyance, to the effect that a Special Committee of the Council should be elected, outside the Electricity Committee, with power to bring in anyone whose advice the Committee consider advisable. We shall shortly hear more of this resolution. It is not at these places only where there is piquant dissatisfaction with the position of electricity affairs, though it is kept concealed as much as possible.

There is room for looking sympathetically and benevolently upon the perpetual confidence that the Boards of Power Companies avow that they feel, despite adversity. The Lancashire Power Construction Company need more capital; ways and means have been discussed with a committee of shareholders; and a scheme of getting hold of more capital has been propounded. People who have surplus cash that they are not very particular about seeing again should note that the district in which the Company operate (according to the report) contains a large number of potential power users; but things are so good in Lancashire (according to the Chairman) that the manufacturers will not introduce electrical power. If they will not spend the money for the purpose when trade is booming, they will not do so when things are bad. According to the report, the Board are confidently expecting, within a comparatively short time, to so enlarge the business as to make it profitable. According to the Chairman, the Board have had an amount of "trying and heart-breaking work." It is a pretty sight to see such confidence under such distressing circumstances. The shareholders have agreed to issue more capital; and the Directors, among other things, will devote a portion of the funds if they are placed in their keeping to the development of the hire-purchase system. This seems an indispensable branch of business if electrical driving is to make any great headway among manufacturers.

Which was it? It is a rather common occurrence to find the electrical papers disagreeing in their facts in reporting news when coal gas is concerned, or is alleged to be concerned. There was a case at the Manchester Assizes the other day, in which Mrs. Leah Ellison sought to recover damages for the loss of her husband who had been suffocated. Suffocated by what? The "Electrician" and the "Electrical Review" are at variance on the point. The former says that the "members of the family were aroused by fumes which originated from the fusing of an electric cable." The "Electrical Review" report asserts that Mr. Ellison was suffocated by an escape of gas which found its way into the house from an outside main—the escape having been caused by the fusing of an electric cable. There is one thing positively certain about this, that the fusing of an electric cable was at the bottom of the mischief, just as it was at the alarming fire the other day near the Moorgate Street Station of the South London Tube. Before the Manchester case ended, the Manchester Corporation consented to judgment being entered against them for £125 and costs.

Increases in Gas Consumption at Buenos Ayres.

Referring to Mr. H. E. Jones's remarks at the recent annual meeting of the Primitiva Gas and Electric Lighting Company of Buenos Ayres, as to the increase of business brought about by the installation of branch offices and show-rooms, it is interesting to note that the Primitiva Company installed seven such offices in the early part of 1907; and the following figures of resultant increase in business speak for themselves:—

Half year ending March,	1907,	the increase was	1·24 per cent.
Do. September,	1907,	do.	12·00 ,,
Do. March,	1908,	do.	18·40 ,,

While the previous yearly increases were: In 1902, 5·75 per cent.; 1903, 1·24 per cent.; 1904, 4·69 per cent.; 1905, 4·26 per cent.; 1906, 0·34 per cent.; 1907, 10·57 per cent. These figures tend to show that branch offices not only bring to the notice of the public the utility of gas appliances, but also make for a much better attention to consumers' complaints, as it is thus possible to localize the inspectors and gas-fitters, the complaints, meter, and maintenance staffs, &c. The Primitiva Company not only undertake the maintenance of consumers' mantles, both in houses of business and in private houses, but also the monthly cleaning and adjustment of their cookers. For the former service they charge an additional price for the gas consumed, which they have found far and away more satisfactory, on the average, than the system of having a fixed charge per burner. For the latter service, they make an addition to the hiring charge. It should be borne in mind that in Buenos Ayres there are three Gas Companies in competition, and the majority of the buildings have services of all three; so that a dissatisfied consumer finds it very easy to transfer his custom from one Company to another.

THE INSPECTION OF FACTORIES.

THE report of the Chief Inspector of Factories—Dr. B. Arthur Whitelegge, C.B.—for the year ending Dec. 31 last, which has recently been issued, contains a few matters that are of interest to "JOURNAL" readers.

The Factory and Workshop Act, 1907, which came into force at the beginning of the present year, deals with laundries, and with institutions in which industrial work (laundry or other) is carried on; and by it certain sanitary requirements—for instance, the separation of stoves for heating irons from ironing-rooms and ironing-tables, and prohibiting the use of gas-irons emitting noxious fumes—are extended to laundry workshops as well as factories. The Notice of Accidents Act, 1906, the provisions of which became operative on Jan. 1, 1907, altered the standard of reportability and imposed on occupiers a new duty of notifying certain classes of dangerous occurrences specified in an Order made in December, 1906. The administration of the Workmen's Compensation Act, 1906, does not rest with the Factory Department; but the Act confers new responsibilities upon certifying surgeons, and it has been attended with an increase in the total of reported accidents and poisoning. At the end of last year there were upon the registers 110,276 factories and 146,917 workshops. Abstracts and other papers were issued to the new occupiers of 501 textile and 7836 non-textile factories, 20,604 workshops, 877 factory and workshop laundries, and 662 other premises—making 30,480 in all. The formal notices and reports received from occupiers, certifying surgeons, and others, numbered 456,294, including 124,917 notices of accidents and "dangerous occurrences," 191,294 overtime reports, and 33,590 humidity records. The inspectors forwarded to district councils 6833 formal representations and 17,254 notices of occupation of workshops; the corresponding figures for 1906 being 6751 and 13,354. In addition to other written instructions and correspondence, 87,567 notices of contravention of the Acts were sent to occupiers by the inspectors, compared with 76,061 in 1906; and 300,000 circulars were issued from the Central Office, explaining new Acts and Orders.

On the subject of ventilation, Dr. Whitelegge states that two kinds of standards of ventilation are recognized by the Factory Act—the hourly delivery of fresh air, and the proportion of carbonic acid in the air of the room. The two are theoretically commensurate, on certain assumptions—viz., that, on an average, 0·6 cubic foot of carbonic acid is given off per head per hour in respiration; and that the fresh air and impurities are uniformly diffused throughout the rooms (a condition which can never be literally fulfilled). It is necessary also to take into account the proportion of carbonic acid in the open air. This is generally assumed, for purposes of calculation, to be 4 per 10,000; but it is usually less, and may occasionally be more. Thus with a fresh air delivery of 600 cubic feet per head per hour, the proportion of carbonic acid in the air of the room will not average less than 14 per 10,000. It must be somewhat greater in parts, and much greater if the diffusion is faulty. Any short-circuiting between inlets and outlets implies removal of comparatively pure air, and some degree of failure as regards the intended removal of impurities, so that the air of the room will be more contaminated. Carbonic acid standards are in force in certain textile factories. A standard of 9 per 10,000 is the limit in humid cotton cloth factories, without any modification to meet the use of gas for lighting or allowance for occasional excess of carbonic acid in the open air. The above-named standard is also required in flax, hemp, and jute mills in daylight; but when gas is being used the limit is 20. Alternatively, the requirement is held to be satisfied if the carbonic acid does not exceed that of the open air by more than 5 parts per 10,000. The Ventilation Committee in 1902 proposed a standard of 12 for factories and workshops generally. This has been useful as a guide to the Inspectors in the absence of a prescribed limit.

The Chief Inspector remarks that the Act requires adequate measures to be taken for securing and maintaining a reasonable temperature in each workroom, and that these measures must not be such as to interfere with the purity of the air. For sedentary occupations, it should not be less than 55° Fahr.; and this was pointed out in the general circulars issued to employers in 1907. In many instances it has been found that no provision whatever has been made other than unventilated gas-jets, which are stated to "contaminate the air." Dr. Whitelegge says flueless gas-stoves are open to the same objection, "though it has been contended that some of them consume the products of combustion, and even that in certain localities the gas itself is so purified that it does not add impurities to the air." Another drawback is that they fail to effect any ventilation. Lighting is not included among the standard requirements of the Act; but occupiers have been reminded by circular that every workroom should have adequate windows, as well as means of artificial lighting for the proper illumination of all parts in which persons are permanently employed. This is important in those kinds of fine work (more especially on dark materials) which involves strain upon the sight.

The rapid increase in the use of machinery is a matter of common knowledge, though there are no available direct statistics, apart from the special returns collected by the Department with reference to the textile trades. As regards fencing and other precautions, the requirements of the Act are strict, and have been supplemented by special rules and regulations. The necessity of

adequate fencing is impressed upon occupiers by repeated circulars and published reports, by constant instructions (written and verbal) from the Inspectors, and by direct pressure from insurance companies. It is stated that many prosecutions have had to be taken against workmen as well as employers. This matter has always received close attention by the staff, and increasingly so in recent years. The published reports show that year by year machinery in general becomes better fenced. In every year's report, however, complaint is made by the Inspectors of fencing being often deferred until they arrive, of machinery for home use not being fenced by the makers as it would be for export, and of guards being wilfully thrown aside by workmen. Still there can be no doubt as to the great advances made, though it is unfortunately impossible to estimate the accidents which have been prevented. It has recently been shown by Sir John Brunner with regard to the works of Messrs. Brunner, Mond, and Co., and it had previously been brought out by Sir George Livesey in the case of the South Metropolitan Gas-Works, that the liability to accident diminishes in proportion to the age and experience of the men employed. How far this is the general rule remains to be seen; but Dr. Whitelegge says it is in harmony with the observed heavier relative incidence upon young persons. Fencing is not the only matter requiring care in connection with machinery. The dangerous practice of cleaning it when in motion is a fruitful source of accidents.

Both prosecutions and convictions in 1907 outnumbered those of any previous year; and the penalties, on an average, were higher. There were 1699 persons prosecuted in respect of 4474 cases; 3277 being on account of employment. There were 4211 convictions; 133 cases were withdrawn on payment of the costs; and 130 were dismissed. The total penalties amounted to £4133, or an average of 19s. 8d. per conviction; while the costs were £1860—an average of 8s. 7d. At the end of the year the authorized staff of all grades was 165; and, with the exception of one vacancy, it was complete. Sanction has been obtained for a further large increase to be carried out during the current year, raising the total strength to 200.

AMERICAN PRACTICE OF GAS PIPING AND GAS LIGHTING IN BUILDINGS.*

This book was briefly noticed in our issue of June 23 (p. 853), but it is now proposed, for the information of readers, to make some further, though not lengthy, reference to its contents. The author is Mr. William Paul Gerhard, a consulting engineer for hydraulic and sanitary works, and a member of various American technical institutions. Mr. Gerhard has during the last twenty years issued one or two books and several pamphlets on gas lighting and fitting, and is certainly a strong advocate of the industry, doing good work in the much to be desired education of the public in gas matters.

The present volume deals with the installation and use of gas on the consumer's premises, and is written "to explain how fitting should be done so that gas may be advantageously employed in indoor illumination." Mr. Gerhard states that his book "is intended chiefly for the use and the enlightenment of the gas consumer and the householder," although he suggests that it will also be useful to architects, engineers, builders, and even to gas companies. There is much in the volume which will be serviceable to the consumer, and, indeed, to the average architect and builder; but we doubt its suggested value to those directly connected with gas companies, and therefore versed in modern-day methods. So far as both the gas consumer and the builder are concerned, the value of the book has been seriously discounted by the fact that in lighting matters, the author is not up to date. Justification for this statement will be found in what we have to say when dealing with the chapters devoted to the subject.

Some indication of the ground covered in the 278 pages of the volume is afforded by the headings of the more important chapters. Mr. Gerhard first deals with some popular fallacies and prejudices, and then usefully describes the general advantages of gas. The next few chapters treat of the arrangement of piping in buildings, and include the usual fitting specifications, tables, and regulations. Gas illumination, gas-burners, pressure, globes, fixtures, and meters have each a chapter. The illumination of interiors and the lighting of country houses are discussed. Then follow two chapters dealing with the relation between gas companies and users, and practical hints for gas consumers. The remaining part of the book is devoted to general facts about gas supply and to possible accidents and dangers resulting from the use of gas. The book bears internal evidence, such as repetition of theme and description in different chapters, of being a compilation and reprint of scattered articles; and this is further indicated by the fact that many of the titles of chapters are those of pamphlets and articles written by the author during the past 14 or 15 years. Matter thus collected in book form can be of great use; but careful selection and revision should have obviated the repetition of the same thing in different parts of the book.

If our surmise be correct, that most of the chapters were once magazine articles, explanation is at once found, although it is by no means an excuse, for the out-of-date advice given in the sections devoted to burners and illumination generally. Here Mr. Gerhard writes as probably he wrote in his 1894 pamphlet, which had much the same title as the chapters in question. It seems deplorable to find an author, otherwise well up in his subject, advising, in this advanced age, the fitting up of a house with flat-flame burners. Yet, taking an example, we note that Mr. Gerhard seriously recommends 3 cubic feet ordinary burners for kitchens, a 4 cubic feet burner for the hall, a chandelier with 4, 6, or 8 burners for the dining-room, and "large 5 or 6 cubic feet burners" for the drawing-room. The whole of the chapters on burners, pressure, globes, and fixtures, deal with flat-flame burners and their congeners. The incandescent gas system, it is true, is mentioned here and there, but only as a comparatively new thing, and not yet for recommendation. The reference, partly historical, occupies less than two pages, and is of a "hearsay" character. To the author, "gas lighting signifies the artificial illumination of interiors and of streets, parks, and public squares, by means of gas-flames or gas-jets." These are his own words to the reader, who can only infer, both from the statement and the book generally, that "flame" lighting is the best that the gas industry can do. It is unfortunate, for what Mr. Gerhard has said on piping, installation work, meters, and other matters is excellent in its way. Had he curtailed the descriptions of flat-flame burners, argands, regenerative, and albo-carbon lamps, relegating them to their proper place, and then written two or three good chapters on incandescent gas lighting, the book would have been acceptable to both gas-fitter and consumer.

As it stands, the book cannot be said to really represent the American practice of gas-lighting. It probably does do so with regard to gas piping; and it is in this section that Mr. Gerhard is safest to follow. The author gives fairly full directions as to service and house piping in all its branches, adding to these, various hints and suggestions derived from other sources, and following up with the usual tables of pipe sizes. He also includes specimen fitting specifications, and reprints the regulations and rules issued by several of the chief American gas companies. We are glad to note the importance attached by the author to the adequacy of gas-piping, and the emphasis with which the gas consumer is told that a large service pipe or meter does not necessarily mean an increased gas account, but, on the other hand, ensures a satisfactory gas supply. Much stress, too, is laid on the necessity of careful workmanship and the subsequent testing of the piping. American gas companies do not agree in their specification of the pressure to be used; but Mr. Gerhard, in his own practice, insists upon 9 to 10 lbs. per square inch, and this may be very advisable under the varied conditions of American gas supply. Periodical or annual testing of pipes is also recommended. It may be noted, in passing, that the author confines himself to the fitting work necessary for lighting devices. Gas fires and cookers, although alluded to, do not come in for discussion. In the chapter on gas-meters, the author draws the consumer's attention to the fact that these instruments are much more reliable than the public sometimes choose to believe. It is not perhaps necessary to discuss the remaining pages. Accidents and mishaps due to gas are dealt with more fully than necessary; and what has been said as to possible troubles may somewhat frighten timorous gas users where the common-sense directions of the author indicate there is no need for fear.

We have animadverted so strongly on the antiquated character of the author's treatment of burners and their accessories that it would be perhaps ungracious to criticize other features of the book. One would like, however, to suggest the advisability of including in another edition a few illustrations of (say) typical pipe installations, burners, and fixtures; and a fuller discussion of light in relation to space, the effect of globes and reflecting surfaces, and the like, would be useful.

The thanks of the gas industry are due to the author for his contribution to a good understanding between gas companies and consumers, for in a book intended for the more general public he has not failed to point out that gas suppliers do not neglect the true interests of their customers.

* "American Practice of Gas Piping and Gas Lighting in Buildings." By Wm. Paul Gerhard, C.E. New York: M'Graw Publishing Company. London: E. & F. N. Spon; 1908. [Price, 12s. 6d. net.]

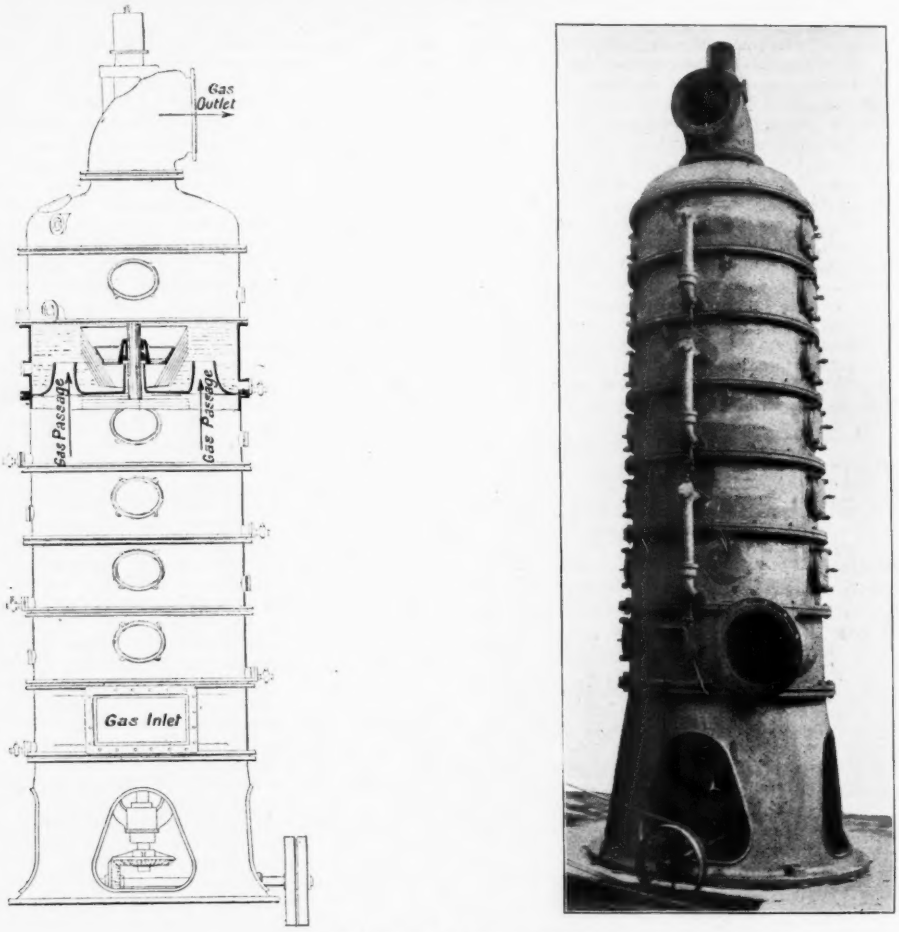
The "Financial News" on the Laindon Prospectus.—The following was the first editorial paragraph in the "Financial News" for the 20th inst.: "The 'Journal of Gas Lighting' has a powerful indictment of the Laindon gas prospectus, from the legal and technical side. Our contemporary's criticism, added to our own analysis of the financial element, ought to lead to the withdrawal of the last of the outstanding applications for shares." Our contemporary's remarks evidently referred to the observations which appeared in the "JOURNAL" two years ago.

The Proposed Gathering of Junior Associations in London.—In the "JOURNAL" for the 14th inst., it was announced that a gathering of the members of the Junior Gas Associations would be held in the Congress Hall at the Franco-British Exhibition on Saturday, the 29th prox. We are asked by the Secretary of the Manchester and District Junior Association (Mr. J. Alsop) to request members of the different Associations to intimate to their Secretaries whether or not it is their intention to join in the gathering, so that the necessary arrangements may be proceeded with. As already mentioned, Mr. W. J. Liberty, the President of the London and Southern District Junior Association, has been elected Hon. Secretary of the Reception Committee.

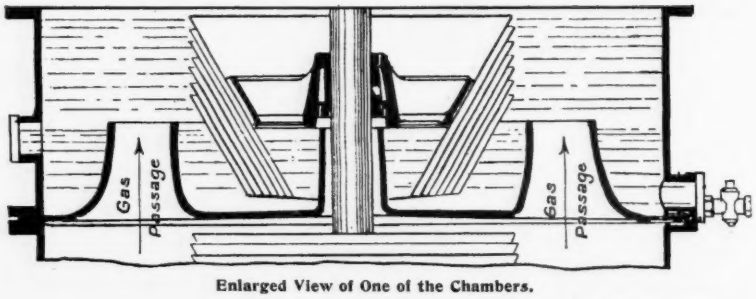
THE FIRST FELD CENTRIFUGAL GAS-WASHER BUILT IN ENGLAND.

Inspection at the Works of Messrs. R. & J. Dempster, Limited.

THE visit that a number of gas engineers were privileged to pay to the works of Messrs. R. & J. Dempster, Limited, at Newton Heath, Manchester, yesterday week, constituted for them a technical treat of the first order. There was concentrated in this one visit more interest for the gas technician than is sometimes to be drawn from a whole formally-arranged meeting for the discussion of the ordinary technical and commercial topics that engage the engineer and manager of a gas-works in these times. The main object was the inspection of the novel and ingenious gas-washer that Herr W. Feld, of Hoenningen-on-Rhine, has devised. But there was a secondary object. The washer is the operating centre of a system; and that system has for its design the treatment of crude gas in manner, also entirely novel, so as to remove all the constituents that are impurities in the gas, and yet have marketable value. About the system as a whole, and about its practicable application in gas-works, we cannot yet say much. It has to be looked upon as an ingenious scheme that has in each of its component parts to be proved. It opens up new roads for thought, for trial, for investigation; and we can but hope that the ambitions and the confidence of Herr Feld will eventually be fully justified. But as to the washer itself, there was not, so far as



Feld's Patent Centrifugal Washer.



Enlarged View of One of the Chambers.

could be gathered, an adverse opinion in regard to it, among the whole of the assembled engineers. They looked upon it, saw the simplicity of its working, its freedom from complication, and its power; but, of course, its effect could not be judged under the circumstances. They also marvelled that the application of the principles for the same purpose had not occurred to someone before, and admired the skill and ingenuity of the inventor.

Once more, we of the gas industry have to accept the rebuff of experience for our conservatism. There is a feeling among us—denial is useless—that what is not born of the gas industry through the skill and inventiveness of its own workers, cannot be of any great advantage to the industry. We sometimes deceive ourselves. Here we have an inventor who, some four or five years ago, had no association with the gas industry. He was a physicist and a chemist directing his brilliant accomplishments, intuition, and fertile faculty for devising expedients for attaining ends in other industries; and then, in considering the recovery of cyanogen, he was brought into contact with the gas industry. He came into it free from bias, and free from the confinement and influence of orthodox practices. His first impressions apparently were that our purification methods and practices in bye-product recovery were crude and unsatisfactory. Hence the resulting work that has produced the new washer, which, quite apart from the new purification system as a whole (about which there is more yet to be learned), has attracted, and is attracting, such wide interest.

Herr Feld and his engineering assistant (Herr Reiser) were present at the reception of gas engineers at the works of Messrs.

R. & J. Dempster, Limited, who, by the way, have secured the rights as sole manufacturers of the Feld washer in Great Britain and the Colonies. Mr. Robert Dempster, Mr. Charles Dempster, the General Manager of the firm (Mr. R. A. Hepworth), Mr. T. H. Priestman, Mr. J. W. Scott, and others, were present to receive the visitors; but recognizing there was only one thing for which the visitors had come from all parts, North, South, East, and West—from Hull, Liverpool, Croydon, Bristol, Norwich, Birmingham, and many other towns—the President of the Institution of Gas Engineers (Mr. Thomas Glover) and the Senior Vice-President (Mr. James W. Helps) being of the party—no time was lost before all were engrossed in commencing an examination of

The New Washer.

A working drawing in section and plan was first inspected and explained. It was seen that there had been some modifications in the internal structural design since the publication of the original drawing; but the principal one merely consists of a change in the form of the liquid-containing channel in each section of the washer, which is now of semi-circular or basin form (instead of the tun-dish shape as formerly) with, in each section, four passages for the gas from section to section. The whole principle of working remains as before.

Perhaps it will be advisable to introduce here a short description of the washer. As the photograph shows, it is vertical in form, and built up of sections, each of which in its operative part is simply a replica of its predecessor or successor. Packed drums and brushes are altogether absent. The working parts are few; and, as the inside of the washer is examined, it is perfectly obvious that the internal maintenance of the machine is not going to be a costly matter, and, as the velocity of the circulated liquid is watched and tested, it is manifest that there will be a self-cleansing action constantly in progress here, which will be conceded to be an advantage, quite distinct from the main purpose of the apparatus. The washer is constructed on the centrifugal principle, and is composed of a set of chambers—say, three to six, according to the desired gas-treatment capacity—placed one above the other. There is a central shaft, running on ball-bearings at the top of the apparatus, which shaft revolves at the rate of about 120 revolutions per minute—a striking contrast to the leisurely motion of its precursors. In each of the chambers there is a set of cones, each set consisting of six to twelve, attached to the vertical shaft by means of a cast-iron hub. The lower ends of the cones dip into the dish-shaped channel below, which contains the water or other liquid. Through the rotating of the shaft, the water is drawn up on the inside of the cones, and is thrown off at a tangent at the upper edge with tremendous velocity across the open space against the wall of the chamber. Imagine a thick body of mist, so thick that it presents a foam-like appearance, thrown off from the tops of the cones at great velocity, and circulating in its fall with immense rapidity through the general impellent forces at work within the washer; and the reader will be in imagination looking upon what is taking place in each one of these chambers, and looking upon what the gas has to pass through. The thought arises that the passage through successive thick seething sprays of this kind must have some detrimental effect on the gas pressure; but, as a matter of fact, the gas is sucked up and carried upwards by the whirling motion in such manner that the loss of pressure is surprisingly small. It is one of those cases where appearances are opposed to fact.

The dish-shaped liquid container in which the sets of cones dip is provided, as stated above, with four gas-ways, which allow the gas to escape through the finely-sprayed liquid. It will be seen from this that the supply of water enters at the top, and the gas passes upwards from chamber to chamber—their courses thus being in opposite directions; the special construction of the apparatus at the top permitting the gas, we understand, to pass away in a dry state. The outflow of the liquid from the washer is regulated entirely by the inflow, *plus* what is taken from the gas. From this it will be seen that any concentration of liquor can be worked to by simply controlling the admission of the water, and using the content of the washer over and over again. The washer can be employed equally as well with turbid liquids as with clear ones, and, through the constant and rapid rotation, there can be no sedimentation. The water passes down from chamber to chamber; and the bottom of the apparatus is so devised that no settling can take place there—all of the liquid contents passing away at the bottom; and the gas, as mentioned, at the top.

The power required to drive the washer is very moderate. The smallest size washer, capable of treating about ¼ million cubic feet of gas per twenty-four hours, can be driven by ½-horse power; and so on up to the largest size, capable of dealing with 45 millions a day, for which not more than 12-horse power is needed. The washer can be driven by belt from a small steam or gas engine, or where there is an electricity generating plant on the works by an electric motor.

The Efficiency of the Washer.

Regarding the efficiency of the washer, this is reported to be high; but, of course, there are no results yet from working in this country upon which to speak definitely. But from Germany, report is, consistently, extremely favourable. Those who saw the washer and witnessed its action at Messrs. R. & J. Dempster's works were impressed with the action and operation, and had no reason, judging from what they saw, to in any way doubt the claims. Those British engineers and chemists who have investigated the working of the apparatus on the Continent are satisfied that the claims as to the effectiveness of the machine for the ordinary purposes of gas washing are valid and well-founded. There we stop, with the hope that very shortly experience—possibly first in Birmingham—will speak for itself.

What was Seen.

After the visitors had examined well the working drawings of the new washer, they were taken to one of the stores on the works where the lower portion of one of the machines had been set up, and connected to an engine by a belt-drive, in order that an inspection might be made of the operation of the apparatus. The top had been left open; and staging erected to enable the examination of the effects of the centrifugal action aided by the internal construction as already described. In the sides of the casing, the flanged doors for access to the interior of the chambers had been glazed, so that the constantly agitated froth produced by the mist at the sides could be seen. Mounting the staging to peer into the top of the machine, all that has been described—the mist and the swirling water—were seen. It was all exceedingly interesting; and the like for the purposes of gas washing had never been witnessed before.

From the stores, the party went to one of the shops, to see the first Feld washer constructed in this country. It is destined for Montreal. It is of 3 million cubic feet capacity per twenty-four hours; and it was noticeable that the ground-space occupied is very small. As a matter of fact, this one is only a shade over 5 feet in diameter, and about 23 feet high overall. It is, of course, raised off the ground for the central shaft and operating connections, liquor outlet-pipes and so on; and above the chambers there is the head of the washer containing the connections. But all this is included in the overall height. This particular washer contains six chambers, each of which appeared to be about 1 ft. 8 in. deep. The power sufficient for the operation of the washer, the visitors were informed, was only 1·5 horse power; but for demonstration purposes, the available engine that was being used was of 2½-horse power. It is a strong washer, with an everlasting appearance about it. Staging and a stairway had been erected to the top of the washer, from which a portion of the casing had been removed, so that inspection could again be made.

A Larger Scheme for Treating the Gas.

The washer must now be left. But it will be borne in mind that it is the apparatus Herr Feld proposes to use in the entire process of purifying gas and recovering bye-products which he has been developing on altogether new lines. During the visit, he gave the party some information concerning the proposed system; but naturally, in doing this, dealing with the subject—and it is a large one—extemporaneously, he treated it somewhat superficially and not with that consecutiveness which will be found when, in due season, Herr Feld can find time to settle down to the preparation of a full account. The process which he is developing, and has under trial, has been adumbrated in the patent specifications, of which, from time to time in the past two years, the principal parts have been published in the "Journal."

Lightly touching the principles forming the framework of the system, it may be described as consisting of the treatment of the gas for the separate extraction of the different impurities and valuable bye-products, each at its most suitable temperature, according to the tension and pressure of these different constituents. In this manner, Herr Feld proposes to extract the tar vapours, ammonia, cyanogen, and sulphuretted hydrogen, in different vessels; and if he can make a success of his system—well, to say the least, it would revolutionize gas plant all along the line between the retort-house plant and the gasholders. In the first place, before cooling the gas the object of the first operation is (as he explained it) the extraction of the "dust and soot," which are the base of tar; the tar being "a mixture of soot and tar-oils of different boiling-points." This portion of the process may be carried out at any temperature between 160° C. down to 40° C. or 60° C.; and, of course, the higher the temperature employed, the more tar and the less tar oils will be obtained. By the washer, therefore, it is, he says, possible to get, in the first instance, pitch with boiling-points above 300° C. and one or more tar oils with boiling-points from 200° C. and above; while all the tar products with boiling-points as low as 200° C.—such as benzol, toluol, and others—which give gas its illuminating power, remain in it.

Herr Feld exhibited some diagrams showing the increase in the volume, in the amount of water, and in the calories per cubic metre of gas of 0° C. and in a dry state if heated, and at the same time saturated with water; and by the aid of these diagrams the process was outlined. Then he proceeded to show some experiments relating to his new method for the wet extraction of sulphuretted hydrogen from gas by means of sulphurous acid absorbed in tar oils, which had been prepared in a way not specifically described, and capable of being used repeatedly in the same process. The sulphur obtained by the action of the sulphurous acid upon the sulphuretted hydrogen is dissolved in the tar oil, which is heated by the reaction; and after a certain amount of sulphur has been accumulated in the tar oil, there is, on cooling, ultimate recovery in the form of fine crystals. Therefore, in this system of removing sulphuretted hydrogen, it is seen that only agents are used which are obtainable in the process of gas manufacture; and also that the other bye-products are recovered in a condition free

from sulphur. The experiments made in this connection were altogether successful; Dr. Colman lending Herr Feld a hand in carrying them out. Of course, Herr Feld recognizes that in gas-works there are, under present circumstances, limitations to the application of the process. But here we have an inventor who encounters an obstacle merely as something fresh that requires to be overcome; so that the wisest thing is to say little or nothing of possibilities and prospects till Herr Feld himself is prepared to unfold the story of the measure of success achieved.

When Herr Feld had made his most interesting statement, we appeared to be suddenly dropped from fascinating projects—excellent from the theoretical standpoint and, when handled by their inventor, seemingly clothed by feasibility—to a very practical level when Mr. Edward Allen expressed some curiosity to know of what assistance the plant would be to him in cooling and scrubbing gas. The washer, it occurred to him, would be an admirable means of enabling the gas engineer to get rid of the tar fog, and at the same time enable him to throw down some of the ammonia before the gas got to the condenser. Herr Feld answered that he should put the tar-washers before the condensers to get out the tar and dust, whereupon Mr. Allen opined that this would require two washers. He also asked whether the inventor would use a little steam to get the tar heated to the proper temperature. Herr Feld's reply was that a little steam-coil would be all that was necessary; and that he could guarantee to extract 95 per cent. In fact, he has extracted up to 98·5 per cent. Of course, the thinner the tar, the better. Then Mr. Glover inquired if it was proposed to use the sulphur that was extracted for the preparation of the sulphurous acid for carrying out the method of sulphuretted hydrogen purification as illustrated by Herr Feld. To which this gentleman replied that it was so, indeed; he used about one-third of the sulphur regenerated for this purpose. He also mentioned, in answer to a further interrogation, that in his system he did not propose to use surface condensers. There was additional conversation in which Herr Feld, Dr. Colman, and Mr. Glover joined. Afterwards, Mr. D. Irving expressed the thanks of those present to Herr Feld and Messrs. Dempster for their kindness in arranging this inspection and demonstration. The apparatus he thought had the appearance of a practical piece of plant; and if, he said, it would only do one-half of what Herr Feld foreshadowed, it would be of great advantage. Mr. Glover, in supporting the proposal of Mr. Irving, observed that those present were all able to see that the washer was on the right principle, that the driving power for the tremendous work the washer was capable of doing was low, and that there was no chance of gas getting through the washer without being efficiently treated. Although they could not at present forecast the future, or pin their faith on the greater scheme that Herr Feld had propounded, the washer would no doubt take the place of less efficient apparatus that they had been using in times past.

All present gladly endorsed the proposition; and following this acknowledgment, there was an early departure from the works that had offered so much interest in regard to the adaptation and application to a new purpose of an old principle, and in regard also to the visions of a complete revolution in the methods of gas purification and bye-product recovery.

We learn that, since Monday of last week, Messrs. Dempster have had the pleasure of showing the washer to Mr. Thomas Goulden, Mr. Forbes Carpenter and one of his Chief Assistants. Dr. Schad, and the Chief Engineer from Messrs. Brunner, Mond, and Co., Limited, and several other gas engineers. It is thus evident that great interest in the apparatus is being evinced throughout the country.

PUBLIC LIGHTING BY HIGH-PRESSURE GAS IN BERLIN.

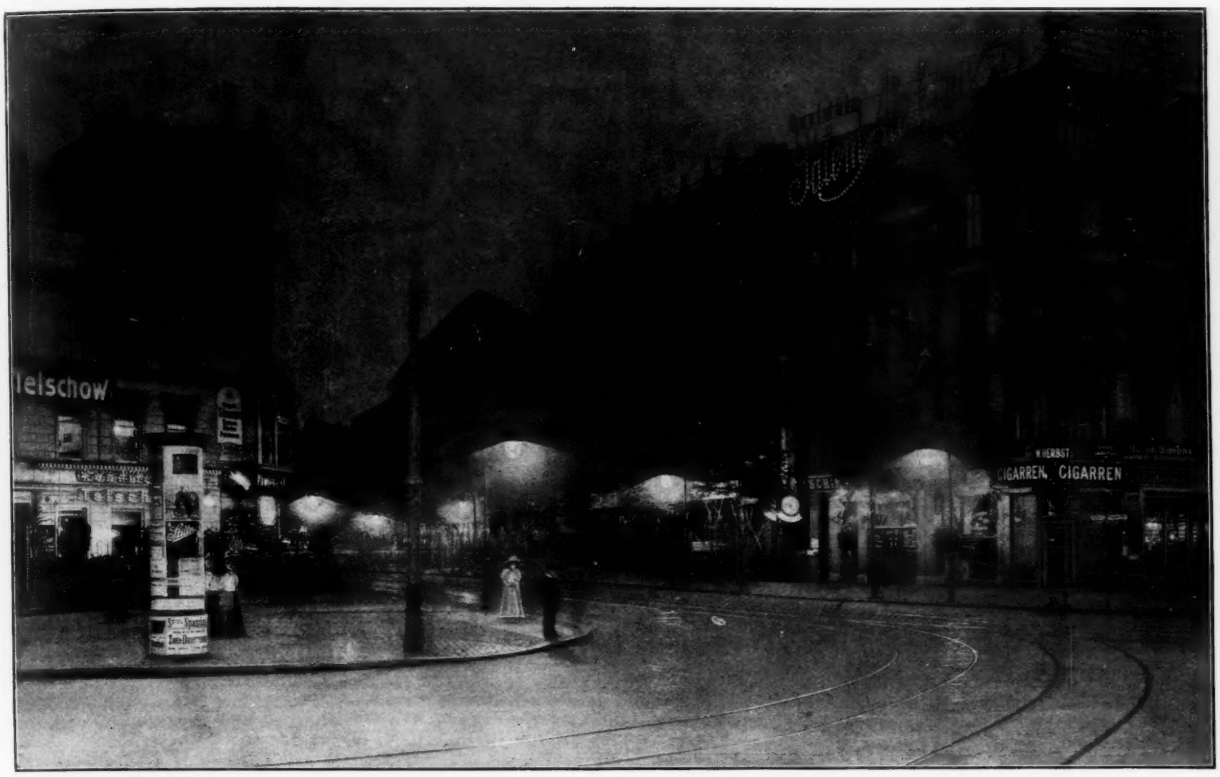
Some particulars were given in the "Journal" for the 23rd and 30th of June (pp. 843 and 920) as to the high-pressure gas-lighting plant of the Berlin Corporation; and the extremely high efficiency of the street lighting thereby attained, was emphasized. We are now able to print views prepared from photographs, taken at night, of the Potsdamerstrasse and Koniggrätzerstrasse (by Messrs. Ehrich and Grätz), which give a good impression of the effect of the high-pressure lighting in these thoroughfares.

In addition to the two compressing stations in the Waisenstrasse and Gitschinerstrasse already described, we learn that a third is practically completed in the Moabit district, and another two are contemplated in other parts of the city. The length of streets provided with high-pressure lighting now amounts to about 25 miles; but during next year it is intended that a still greater number of the more busy streets shall be similarly equipped.

For the most part, the lighting is by two types of high-pressure lamps—viz., one with two burners consuming 21·2 cubic feet per hour, and the other with three burners, consuming 28·25 cubic feet per hour. The former lamps give an intensity of about 1750 hefners (1590 candles) and the latter about 3750 hefners (3410 candles).

The high-pressure distributing system consists of seamless steel socket pipes made at the German-Austrian Mannesmann Tube-Works. The mains are from 40 to 250 mm. (1·6 to 8 in.) diam. The lamp-columns are placed at diagonal distances of 90 to 100 feet apart; and the burners are fitted 17 feet from the ground.

In addition to the high-pressure lighting for public lamps, there are also in Berlin many installations of high-pressure gas-lamps for large buildings—such as factories, the corporation markets, slaughter-houses, and cattle yards; but in these cases private compressing plant is used, as the high-pressure gas from the street-mains cannot be applied for private lighting, because the high-pressure system of the mains is so controlled that the lamps connected with it are all lighted and extinguished at a given time.

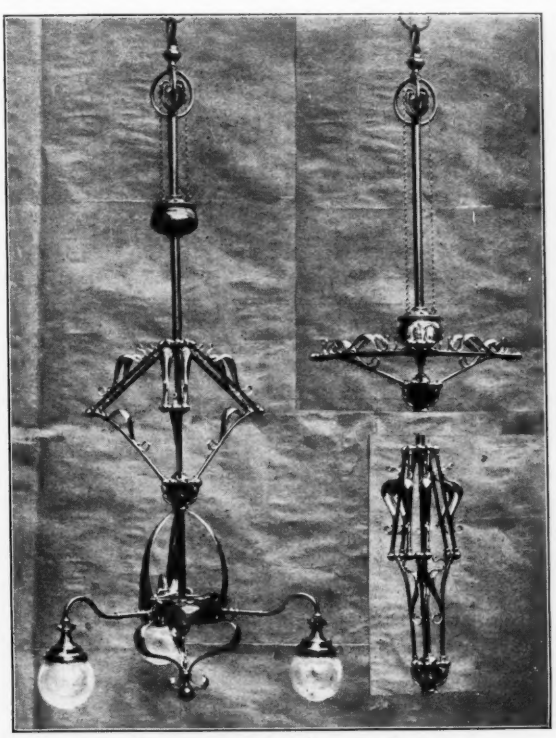


CHANDLER'S PATENT CHANDELIER.

In an editorial article which appeared in the "Journal" about two years ago, we condemned, in rather strong terms, the use of the old water-slide chandelier, which had recently caused several accidents, and suggested that it was high time gas suppliers made some special effort to "rid the houses of the consumers of these death-dealing survivals of a past period in artificial illumination." Since then, a good deal has been done in the direction of superseding this acknowledged source of danger in connection with domestic lighting; but much still remains to be accomplished before this old offender is abolished. The question as to whether the omission of the user to re-water his chandelier is or is not an almost criminal oversight, in view of the disastrous results which may follow, is of less importance than that of the responsibility incurred by the gas seller who fails to inform his customer, by printed notice, of the risk he runs by retaining the old-style gas-fitting in his house. The South Metropolitan Gas Company have already, as our readers may remember, taken laudable action in this direction by distributing a notification on "Dangerous Chandeliers;" and gas managers should, we think, show their appreciation of it by doing something similar. If they do not, they incur a certain amount of moral responsibility. At one time, there was nothing to offer consumers as a substitute; but, happily, this state of things no longer exists.

In the "Journal" for the 14th inst., there was described and illustrated, in the "Register of Patents," a new pendant devised by Messrs. S. & J. Chandler, whose names are well known in connection with rotary washer-scrubbers; and we now give some further particulars in regard to it. It is claimed for this appliance, which is shown in the accompanying illustration, that it is an absolutely safe and reliable substitute for the water-slide chandelier. The radial arms, attached as they are to the body of the solid telescopic rod, form in different positions what may be described as a series of ornamental transformations, varying in appearance and position with every inch of vertical movement. Of course, the gas flows by one or more of these arms; but the rigidity of fixture and truth of vertical line depend entirely upon the solid telescopic rod, while the extension movement up or down is as true and as easy as in the case of an ordinary telescope. The function of this rod is to centralize the movement of the lateral arms at every point; and while this is so, it is never in contact with the gas. This will be quite understood by reference to the specification accompanying the filed drawing in section (*ante*, p. 118), which describes the patent as applied to an ordinary single light for small rooms. It will be seen that the gas-chamber is formed between an outer and an inner tube; the latter being closed at the top, and forming the guide for the rod. The chamber is closed at the lower end by a flange, which serves to secure the rod at any point of extension; and the effect is that the radial arms are supported in a perfectly vertical movement.

The invention as applied to two, three, five, or more lights necessitates the adoption of the arrangement shown, partly in section, in the diagram, *ante*, p. 118, and fully illustrated in the photographs. It will be noticed that the counterbalance weight is central, and slides noiselessly on the outer tube of the chandelier. The chains, passing over what might be termed inverted pulleys, are connected or attached to the top of the telescopic rod; while the gas is conveyed from the top body to the outer jacket of the chandelier by the means shown. In this case it will be understood that the telescopic rod chamber is open at both the top and the bottom, and when the light is drawn down,



no chains are visible, as, of course, they are inside the outer jacket of the chandelier. By these means the travel up or down is perfectly true, without shake or want of rigidity. This is an element of importance when an incandescent mantle is used. In the Chandler chandelier, no water-joint, stuffing-box, cork slide, or rubber tubing is used or required. It lends itself to any design, and is adaptable to any number of lights.

RECENT IMPROVEMENTS IN CONNECTION WITH GAS-WORKS INSTALLATIONS IN GERMANY, WITH SPECIAL REFERENCE TO THE KOPPERS PATENT INCLINED COKE-OVENS ERECTED AT BOCHUM GAS-WORKS AND TO KOPPERS' IMPROVED AMMONIA RECOVERY PLANT.

By Herr A. PETERS, of Cologne.

[A Paper read before the Rhineland and Westphalian Gas Association.]

The progress which has recently been made in the construction of retort-benches at gas-works is the result of endeavours to render the working of the plants independent of hand labour, by substituting labour-saving mechanical arrangements. The heavy duties of the workmen are very greatly lightened, as it is now practically only necessary for the men to attend to the mechanical arrangements for charging and discharging the retorts. It is essentially necessary for mechanical means to be provided in connection with horizontal retorts for charging them with coal and pushing out the coke as well as for loading the coke into trucks. The adoption of inclined retorts enables a considerable saving to be effected in the charging and discharging operations. With vertical retorts the coal is fed from above, and the coke falls directly into a coke-loading arrangement, which system permits of the charging and discharging operation being effected entirely by mechanical means.

In gas-works, the principal object is the production of the greatest possible amount of illuminating gas; the coke obtained is regarded more or less as a bye-product. In coke-works, on the other hand, the chief aim is, of course, to produce the best possible quality of coke suitable for metallurgical purposes. The gases of distillation obtained in the latter process are employed principally for heating the coke-ovens. In gas-works, the coke is utilized largely for heating the retorts. In order to obtain a suitable coke from coke-ovens, it is necessary for the coal to be of a bituminous or semi-bituminous character, or a mixture of both these kinds. For the production of illuminating gas, on the other hand, it is essential that the coal be of a highly volatile character. The discovery of the incandescent gas-mantle has not affected in any way the construction or working of either processes; but it has its effect on the quality of the gas produced, in that it is now not so necessary for the gas to be of a high illuminating power, but to have a higher heating value. The production of gas of uniform quality is just as easily obtained from coke-ovens as from ordinary gas-retorts, and it depends altogether upon the nature of the coal and upon the method of coking.

In ordinary coke-ovens, gas can be produced from so-called fat coal (rich caking coal), lean coal (semi-bituminous coal), and manufacturing coal. The gas from these coals, however, is not of such a highly illuminating character as that from a good gas coal; but it nevertheless has about the same heating value. In the appended statement, the results are given of tests of four varieties of coal which were carefully carried out in an experimental coke-oven. Apart from the figures giving the heating value of the gases, the high yield of sulphate will be viewed with the greatest interest. This high yield is due to the relatively small decomposition of the gas in a properly-constructed coke-oven in which the space provided at the top of the oven for collecting the gases evolved from the coal is maintained at a moderately low temperature.

So that the difference between retort-ovens and coke-ovens may be clearly understood, a short explanation is given, as follows: In gas-retorts, small quantities of coal are carbonized in periods varying from four to eight hours. The retorts are subjected on all sides to a more or less intense heat. The section of the retort is oval in shape, and of dimensions which do not exceed 400 mm. by 650 mm. Coke-ovens, on the other hand, are of a very large capacity, having usually a length of 10 metres (32 ft. 10 in.) a height of 2·5 metres (8 ft. 2 in.), and a width varying from 450 mm. to 550 mm. (18 inches to 22 inches). The greatest length of the retort is 6 metres (19 ft. 8 in.), and the capacity does not exceed 10 cwt. The capacity of a coke-oven is from 7 to 8 tons; and it is therefore from 14 to 16 times as large as a gas-retort. The period of carbonization of a coke-oven of modern design is from 24 to 30 hours, and depends upon the arrangement of the heating flues and upon the method of applying the heat to them as well as upon the character of the coal. The extended period of coking and the expeditious method of emptying and filling the oven have a number of important advantages, more particularly in that there is much less loss of heat, less attention is required, and a higher yield of gas is derived. This has been recognized for some time past by gas engineers, and has resulted first of all in the vertical retort being adopted with a coking period of ten to twelve hours, and, subsequently, in the adoption of the coke-oven, with a coking period of twenty-four hours.

The working of coke-ovens differs very essentially from that of ovens designed for the production of illuminating gas, in that the coal contains in the former from 12 to 15 per cent. of moisture, and the coal is, besides, crushed to a very fine state. The moisture in the coal is mostly due to its having been subjected to a washing operation. Water, however, is very often added where the coal is not washed, as it has been found that a better coke is produced from coal containing moisture. The reason for this is that crushed coal in a damp condition is denser than crushed dry coal; and, as a consequence, the resultant coke is also more dense. From some coalfields, such as those in America, where the coal is of a higher specific gravity, a good blast-furnace coke can be produced from crushed coal carbonized in a dry state. The moisture in the coal affects the period of distillation, besides which it necessitates a higher temperature for carbonization; and there are, consequently, great variations in the temperature of the oven. As a result of this, the walls of the oven easily become leaky. From the coal carbonized in retorts, from 4 to 6 per cent. of moisture is yielded as virgin liquor. The carbonizing period of a coke-oven when charged with dry coal is naturally much lower than when charged with wet coal. The ovens, furthermore, remain tight, and the fire-brick material is subjected to less wear and tear.

On reviewing the recent progress which has been made in the gas industry, and comparing it with the history of the coke-oven industry, it will be seen that both industries have developed on parallel lines. The manufacture of coke was effected in the first place in a similar manner to that now in use for the production of charcoal. The next step was the employment of brick chambers formed in the shape of a beehive, and which were called beehive ovens. Some time between the years 1850 and 1860, a vertical coke-oven, known as the Appolt oven, was introduced. This oven was arranged with heating flues in which the gases of distillation

—	Coking Coal.						Inferior Gas Coal.			Gas Coal.			Cannel Coal.
	Lean.			Rich.									
	(1)	(2)	(3)	(4)	(5)	(5)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Ash . . . . . per cent.	9·34	8·20	9·00	7·64	6·10	1·20	4·50	1·18	2·30	2·50	1·50	1·00	5·50
Yield of coke by crucible test ,,	84·80	81·50	80·00	76·16	78·00	72·30	71·40	73·70	64·60	63·10	66·70	66·64	64·40
Yield of coke by distillation test ,,	85·93	84·61	82·75	80·97	81·48	77·33	76·38	80·85	74·04	74·48	75·87	75·64	74·77
Yield of tar . . . . . ,,	1·37	2·16	2·75	1·22	2·50	1·70	3·35	1·65	2·92	2·73	2·21	2·55	1·85
Yield of ammonium sulphate ,,	0·96	1·05	1·27	1·28	1·26	1·30	1·35	1·26	1·53	1·29	1·52	1·50	1·46
Gas liquor . . . . . ,,	3·43	3·10	3·08	4·32	3·62	6·14	5·15	4·08	6·57	5·42	5·47	5·36	4·30
H_2S . . . . . ,,	0·27	0·15	0·58	0·31	0·19	0·25	0·37	0·13	0·34	0·14	0·17	0·17	0·70
CO_2 . . . . . ,,	0·35	0·18	1·05	0·61	0·33	0·96	0·55	0·34	0·66	0·53	0·81	0·63	0·73
Gas per ton of coal without CO_2 and H_2S, at 0° C. and 760 mm. . . .	232·10	243·90	243·70	265·10	274·60	260·70	283·80	284·40	290·10	316·70	310·70	308·40	321·20
Do. do., at 15° C.	244·80	257·60	257·00	284·90	292·70	275·00	299·60	300·00	306·00	334·00	328·40	325·20	346·80
Gas per ton of coal with CO_2 and H_2S, at 0° C. and 760 mm.	235·70	245·90	252·60	270·40	277·60	267·40	289·00	287·10	295·90	320·40	316·10	312·80	329·80
Do. do., at 15° C.	248 40	259·60	266·00	279·60	289·70	281·70	304·80	302·70	311·80	337·70	333·80	329·70	357·50
Heating value of 1 cubic metre of gas:													
Steam Calories . .	4351·40	4547·60	4539·10	4910·50	4731·10	5007·60	5055·90	4803·30	5051·50	5230·10	4948·50	5144·20	5565·80
Liquid ,, . .	4962·00	5064·00	5161·10	5571·30	5386·20	5659·10	5705·80	5452·50	5695·00	5882·40	5587·00	5789·50	6249·60
Heating value of gas from 1 kg. of coal:													
Steam Calories . .	1065·20	1170·40	1166·50	1372·30	1374·30	1376·90	1516·70	1441·00	1545·70	1746·80	1625·10	1673·40	1942·20
Liquid ,, . .	1214·70	1304·40	1326·40	1557·70	1561·90	1556·20	1711·70	1635·70	1742·60	1964·70	1834·70	1883·30	2180·90
N_2 . . . . . per cent.	9·70	9·50	8·40	3·74	8·72	2·56	7·20	3·47	7·69	7·38	6·70	8·57	5·00
H_2 . . . . . ,,	54·33	54·35	53·90	56·01	50·84	53·20	47·58	56·27	46·92	45·72	49·49	43·44	46·90
CH_4 . . . . . ,,	30·77	30·55	31·10	32·65	33·94	33·04	35·72	31·97	34·99	35·40	33·23	37·09	36·10
C_mH_n . . . . . ,,	1·20	2·00	2·20	3·40	2·50	3·60	3·80	2·80	4·10	5·20	3·92	4·00	7·00
CO . . . . . ,,	4·00	3·60	4·40	4·20	4·00	7·60	5·70	5·50	6·30	6·30	6·66	6·90	5·00
Weight of gas . . . . . ,,	8·65	9·80	9·88	12·57	11·88	13·63	14·20	12·95	15·18	16·80	15·47	15·65	17·65
Sp. gr. of gas	0·35	0·39	0·38	0·44	0·41	0·49	0·46	0·42	0·49	0·46	0·40	0·47	0·50

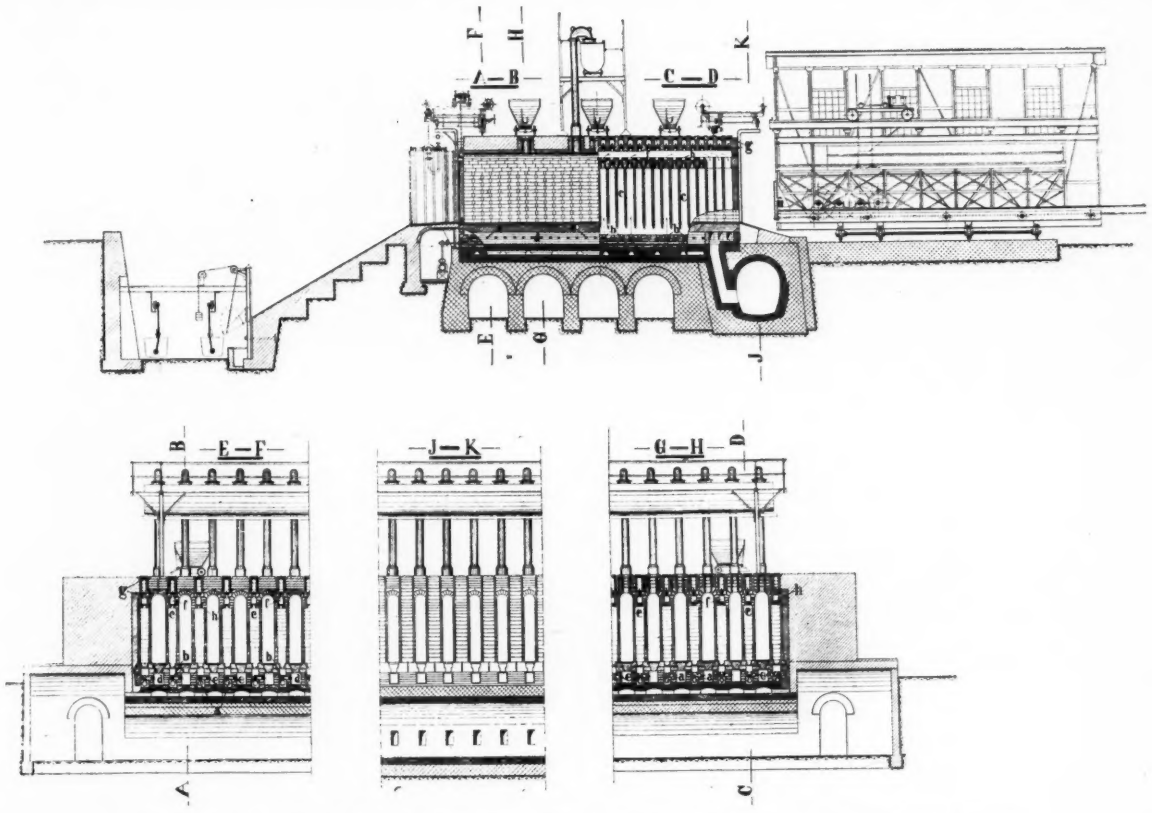


Fig. 1.—Koppers' Patent Bye-Product Coke-Oven, arranged to Suit the Substructure of Existing Retort-Benches.

were consumed for the purpose of assisting the carbonization. This type of oven found some considerable popularity at a number of collieries in the Saar district, in Westphalia, and also in Upper Silesia. The oven was much improved upon from time to time, and was eventually arranged with bye-product recovery plant. There are a number of vertical ovens of this description still at work at an iron-works in Upper Silesia.

The coke industry having been always a progressive one, it was not long before the vertical Appolt oven was discarded, as it possessed the very disadvantageous feature that the heating was by no means uniform. The type of oven which next followed was the horizontal coke-oven of the present day. In the past, well-known firms—such as Collin, of Dortmund, and Von Bauer, of Munich—have erected large numbers of vertical retorts, in the construction of which they introduced a number of important improvements, and in doing so have rendered great service to the coke and gas industries. In recent years, the firm of Dr. Otto and Co., of Dalhausen, have interested themselves very largely with the construction of bye-product coke-ovens. The oven originally built by this firm was the horizontal type, which was constructed on a design invented by Hoffmann. The particular feature of this system was the combination of a horizontal coke-oven with Siemens regenerators, which construction met with considerable success.

The coke-oven built at the present time can be regarded as the forerunner of the latest development of coke-ovens as recently adopted by gas-works. The firm of Dr. Otto and Co., obtained a patent in the year 1901 for a gas-oven arranged at an inclination, which was designed on the same principle as the ordinary coke-oven. About this time, a patent was granted to a Mr. Hermann Schimmel, of Berlin, for a gas-oven arranged similarly at an inclination, on which some important improvements were embodied. The feature of the patent was the provision of means for taking off the gases of distillation during the latter period of carbonization for heating the ovens. This is of special importance for all small and medium-sized gas-works, and for districts where the coke produced can be sold at a high price. The coke-ovens generally in use at collieries are all arranged horizontally. They are charged with coal through several filling holes in the top, or, when the coal is compressed, the ovens are charged by means of a machine through the doors. The coke is discharged by a pushing engine on to a horizontal or inclined bench, whence it is loaded into trucks by hand. The gases evolved from the coal pass into one or two gas-collecting mains, from which they are drawn to the residual plant by means of exhausters.

The great bulk of bye-product ovens in Germany are arranged with vertical heating flues, as it has been established that it is not possible for an oven arranged with horizontal flues to be uniformly heated. In a vertical-flued oven, the heating is effected by means of relatively short flames, while with horizontal flues the flames are of necessity much longer. Long flames are much cooler than short flames; and as the distillation requires a high temperature, it is abundantly evident that the vertical-flued oven is much more efficient than one arranged with horizontal flues. The number of points at which an oven should be heated should be as large as possible, in order to obtain perfectly uniform heating. Vertical-flued ovens having a heating jet in each flue give by far the best results, and enable a gas to be produced which can be employed for exactly the same purposes as the gas manufactured in ordinary gas-works. As a general rule, ample space is available at coke-works for the employment of coke-pushing engines and an extinguishing bench; but with gas-works, on the other hand, the space available is often limited. Large gas-works have frequently to be erected on the smallest possible space, and the working of the plant is consequently attended with difficulties. In such cases the adoption of inclined coke-ovens with mechanical charging and discharging arrangements would be very advantageous.

It is not surprising that a firm who have gained a pre-eminent position in the building of coke-ovens should turn their attention to the building of similar ovens for the lighting gas industry, especially such a firm as that of Heinrich Koppers, of Essen-Ruhr, who have already had considerable experience in this direction, which other firms, by the way, have still to gain. The great similarity which has taken place in the progress and development of the methods of carbonizing in gas-works and coke-works, already referred to, is completed by the employment of inclined coke-ovens at gas-works; and it can safely be taken that this method of carbonizing will be largely adopted in future owing to the distinct advantages offered by the system. It is more than probable that if the building of this type of oven be attempted by other than experienced coke-oven builders, the system would be brought into disrepute, as it would be bound to result in ovens of bad and doubtful construction being erected. Gas engineers contemplating this type of oven would be well advised, therefore, to give consideration to only those constructions which have been proved satisfactory by actual experience. The new method not only enables gas of a good and uniform quality to be produced, but also a very satisfactory coke, which would be equal in quality to ordinary coke from coke-ovens. The field for the employment of the system, therefore, is very greatly extended.

By the introduction of coke-ovens in gas-works, the choice of coal would not be so limited as at present. Any variety of coal yielding even a medium quality of gas, but which would produce a satisfactory coke, could be employed. The adoption, furthermore, of the idea in the lapsed patent of Herr Schimmel—to employ the poor gases taken off at the latter period of distillation for heating purposes—would enable a continuous supply of gas of medium heating value to be supplied to the consumer, while at the same time a coke of a valuable character would be produced. This would be attained without the use of gas coal and by the utilization of coal of a semi-bituminous nature. Rich gas coal itself yields, when carbonized in properly-constructed ovens and in which the gas collecting space is not over-heated, and in which, furthermore, the walls are uniformly heated, a gas of a better quality, both as regards its heating and lighting values, than has hitherto been possible with gas-retorts. The coke is

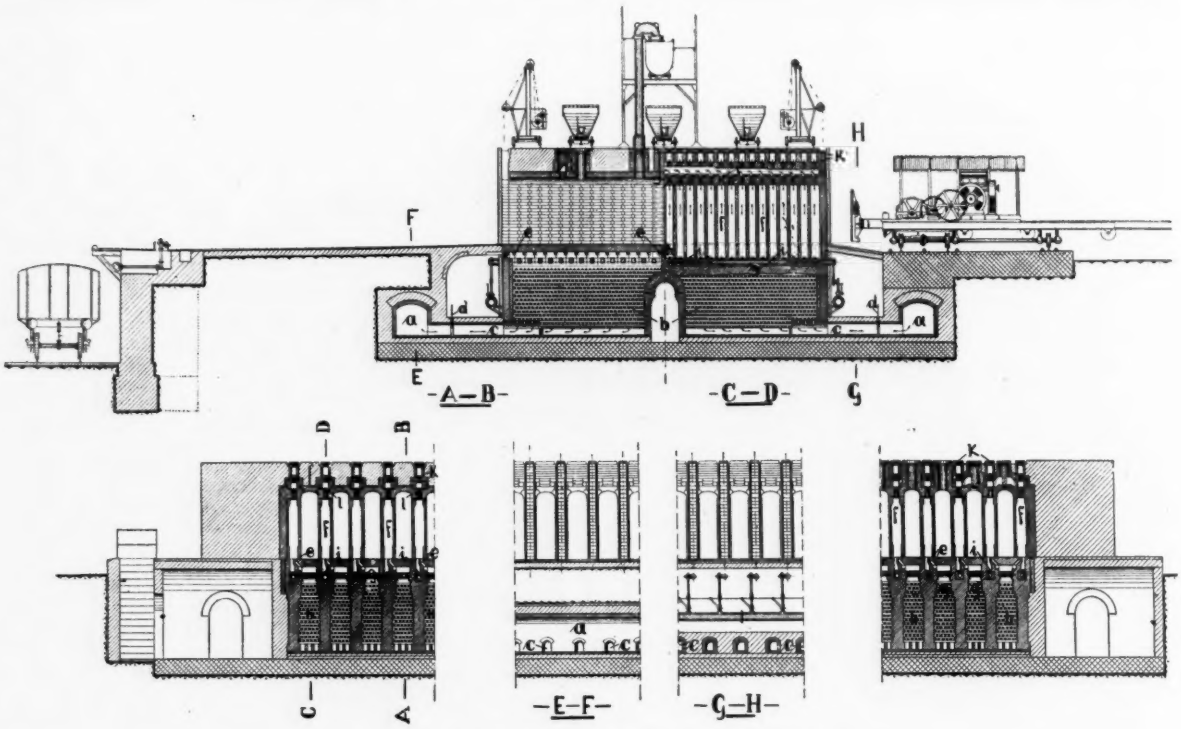


Fig. 2.—Koppers' Improved Regenerator Coke-Oven—Patented 1905.

much denser, and can be employed for foundry purposes, for smithies, and generally for all metallurgical purposes. The yield of ammonia from coke-ovens of good construction is considerably greater than from any gas-works retort, as the quantity of ammonia obtained approaches closely to the theoretical amount as ascertained in the laboratory. The results of laboratory tests, when compared with the actual results obtained at many gas-works, indicate that a very great loss in bye-products takes place, and therefore a correspondingly heavy loss in revenue.

Koppers' Waste-Heat Oven.

Until within very recent years, practically the whole of the gas that was obtained from the distillation of coal in coke-ovens was employed for heating the ovens; the waste gases from the ovens being utilized to raise steam. These ovens are still largely used where steam power is required, and are known as waste-heat ovens. But the ovens which are now being viewed with the greatest favour are those of the regenerator type, which enable from 45 to 55 per cent. of the total quantity of gas evolved from the coal to be obtained as a surplus for external purposes. The waste-heat oven, as built by Koppers, is shown in fig. 1, and the following is a brief description of the construction and working. The gas distributing conduit *a* is placed directly on the top of the brickwork foundation into which the heating gas is delivered. The gas passes into the heating flues *c* through the nozzles *b*. Alongside this conduit the air-distributing flue *d* is placed. This flue is put directly beneath the oven chamber, while the gas-flue lies directly under the heating flues. The air passes into the heating flues through the openings *e*, where it meets the gas as it comes through the nozzles, and combustion takes place at a point on a level with the floor of the oven. The products of combustion pass up the heating flues and enter the horizontal flue *f*, whence they are drawn down the end flues of the oven into the main waste-gas flue leading to the boilers.

The temperature of the heating gases on leaving the oven is about 1000° C. In the short distance between the gas-nozzles and the upper horizontal flue *f*, the whole of the heat which is of value for heating the oven is abstracted by the oven charge. The quantity of heat is about 45 per cent. of that generated by the combustion of the gas and air. Waste heat of less temperature than 1000° C is useless for assisting the carbonization process, and is accordingly utilized under the boilers. The gas is supplied to each oven by a separate pipe fitted with a regulating cock. Every heating flue has its own gas-jet (nozzle *b*), which does not require either attention or cleaning. The gas-nozzles are accessible and removable from the top of the ovens through openings *g*. These openings are fitted with gas-tight plugs, which can be easily removed for inspection purposes. It might be thought that these openings have a detrimental effect on the stability of the ovens. But any fears in this respect would be quite groundless, as up to the present over 3000 ovens have been erected; and in no single instance has any sign of instability manifested itself. It should, furthermore, be pointed out that each heating flue is furnished at top with a regulating slide, by means of which it is easily possible to attain an extraordinary uniformity in the heating of the walls. The regulation of these slides is effected through the openings in the superstructure of the ovens. As a result of the equal heating of the walls, a large quantity of gas remains over. According to the quality of coal, a surplus up to 100 cubic metres of gas per ton is obtained. The sole of the oven is not subjected to any heat, and the resulting coke is dense, large, and homogeneous throughout the charge, which is proof of the correctness of the method of heating.

Since the introduction of reliable gas-engines of large power, the demand has arisen for coke-ovens which will yield a larger supply of surplus gas than is obtainable from waste-heat ovens. This demand has resulted in the regenerator oven being now universally viewed with favour.

Koppers' Patent Regenerator Coke-Oven.

[See fig. 2.]

The Koppers' latest patent regenerator oven differs from all other types in that it has separate regenerator chambers provided for each oven, instead of one set of regenerators for a whole battery. The construction consists of a series of transverse parallel walls built directly upon a concrete bed. The walls extend to the top of the structure, and are so designed that the lower portion forms the regenerators and the upper portion the oven chamber. Apart from rendering the ovens entirely independent of each other, this construction has the important advantage over all other systems that the regenerator chambers can be made of very large capacity relatively to the room they occupy, while they are so enclosed that loss of heat by radiation is almost totally avoided.

The air for combustion enters the regenerator *b* from the air-passages *a*. In the regenerators the air is heated to a temperature of about 1000° C., whence it passes into the vertical heating flues *f*, where it combines with the heating gas at a point on a level with the sole of the oven. The gas is delivered into the distributing channel *g*, and passes into the flues through the nozzles *i*. As the combustion in the flues has of necessity to be reversed at periods of about half-an-hour, the flues are so arranged that the combustion takes place in one period in the flues forming one half of the oven wall, and in the next period in the other half of the oven wall. The gases of combustion pass up the heating flues on one side of the oven and down the heating flues on the other side, and are drawn into the regenerator by the chimney draught. The heat is abstracted by the chequer fire-brick work in the regenerators to such an extent that upon entering the chimney the temperature does not exceed 250° C. The reversal of the combustion is effected by hand or by automatic means. Similarly to the waste-heat ovens, the nozzles are accessible through the openings in the superstructure, through which it is easily possible for the nozzles to be removed and substituted for others for regulating purposes. Each heating flue is furnished at the top with a sliding-brick, which enables the heating to be regulated to a nicety, and so that a perfectly uniform heating of the oven walls is attained. In no other system has it been possible hitherto to obtain anything like such equality in the heating of the oven walls.

The gas from properly-constructed ovens is of a perfectly uniform quality, and is exactly the same in character as that obtained from gas-retorts. Gas is supplied for town illumination from a number of coke-oven plants. The town of Essen is lighted

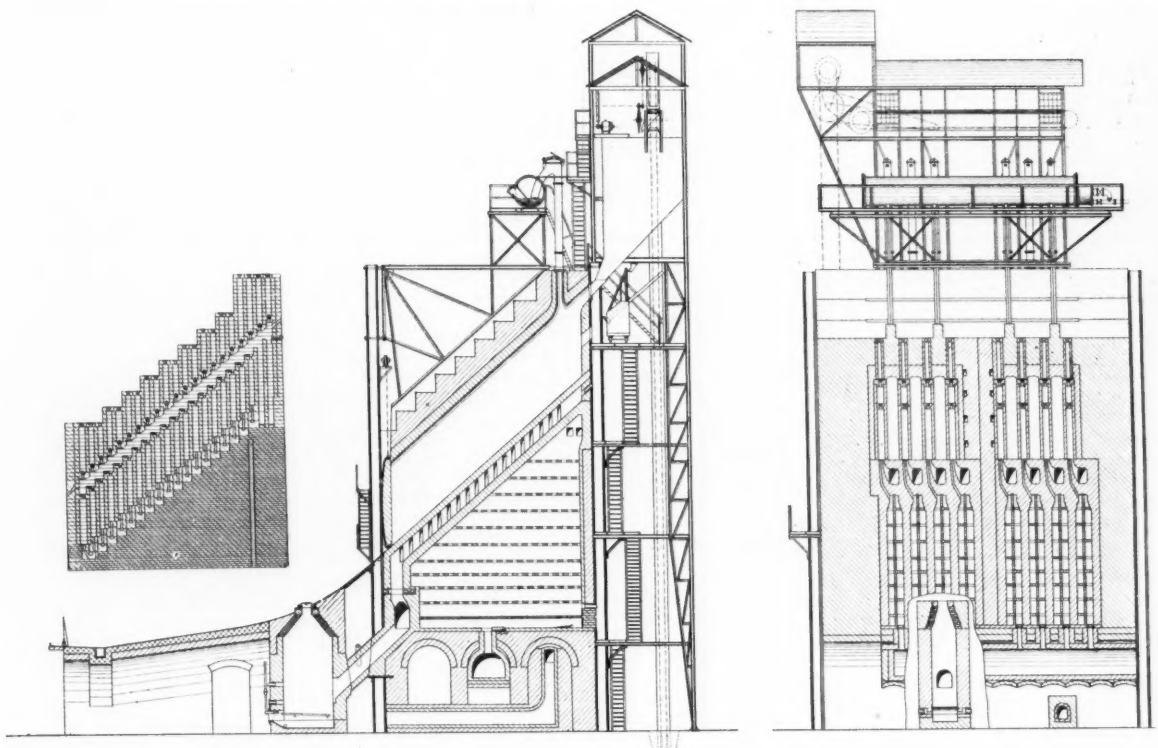


Fig. 3.—Koppers' Patent Inclined Coke-Ovens, as Erected at the Bochum and Vienna Gas-Works.

by gas produced from the Koppers' coke-ovens at the Victoria Mathias Colliery. This gas is of a very superior quality, notwithstanding that it is obtained from semi-bituminous coal. Similarly, the towns of Heinitz, Hutte, Homberg, Mahlstadt-Burbach, Rheinhausen, and the districts surrounding these towns are supplied with gas from coke-ovens at neighbouring collieries. Negotiations are now in progress at Recklinghausen for lighting this town by coke-oven gas. In America, the City of Boston obtains its gas supply largely from coke-ovens.

It is necessary in some cases, where the quality of the coal is poor, for the gases of distillation evolved in the first period of coking only to be used for illuminating purposes; but this is not needful with coal of ordinary coking quality. As will be seen from the table on p. 232, showing the analyses of different coals, the quality of gas obtained from coking coal is almost exactly the same as that from gas coal. From the best gas coal, especially if it contains a comparatively high percentage of oxygen, gas of no better quality or greater in quantity is obtained than from coal of poorer quality carbonized in coke-ovens. The reason for this is to be ascribed to the heating of the retorts being wrong in principle. The retorts are heated on all sides, including the upper portion, which should remain cool; and the gases are to a great extent decomposed. The tar from coke-ovens is always of pretty much the same consistency whatever kind of coal is employed, being of a very liquid nature, whereas tar in gas-works frequently is so thick that it hardly runs at ordinary temperatures. In the more recent type of coke-ovens, especially in that of the Koppers' patent design, the heating of the top part of the oven, where the gases of distillation are collected, is completely avoided; while the sole of the oven is not subjected to a high temperature. No decomposition of the gases therefore takes place. Another great advantage derived from this method of heating is that the yield of ammonia is very greatly increased. According to the quality of the coal, the yield of sulphate reaches the high figure of 1·5 per cent. per ton of coal. On an average, the nitrogen content in coke-oven gas is from 30 to 50 per cent. more than that from gas-retorts. This is of very great importance in connection with the production of sulphate.

Koppers' Patent Inclined Coke-Oven.

[See fig. 3.]

This illustration shows a battery of inclined coke-ovens which are now under construction at the Bochum Gas-Works. They are being built by Mr. Heinrich Koppers, of Essen, and are designed on the same principle as the coke-ovens erected by the same patentee—practically the only difference being that they are arranged at an inclination instead of horizontally. It might be further mentioned that a battery of 15 similar ovens is now being erected by Mr. Koppers at the Vienna Gas-Works. The principal features of the design are the facilities provided for inspection and regulation. The openings in the superstructure for inspection purposes and for giving accessibility to all the heating jets are of special importance, and distinguish the oven from all other systems; while the provision of the regulating sliding bricks over each heating flue is a feature of inestimable value, as these enable the heating of the ovens to be perfectly controlled, which, as already pointed out, is not possible in any other system. The gas for heating the ovens is obtained from a gas-producer, and is delivered into a distributing flue under the oven chamber, whence it passes into the 18 heating flues, where it combines with the heated air from the recuperators.

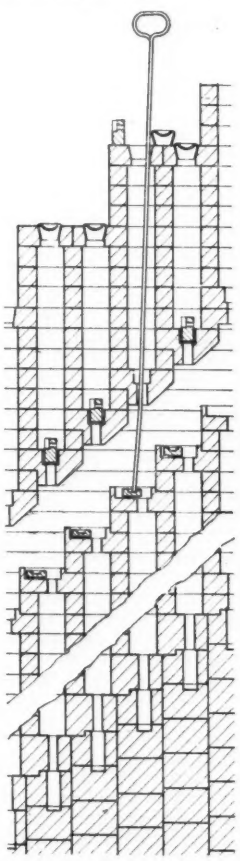


Fig. 4.—Section through Oven Wall, showing Method of Regulating the Heating Flues.

The gas-producer is placed in front of the ovens and arranged in such a way that any movement that takes place owing to expansion and contraction will not affect the brickwork of the ovens. The heat is applied only at the lower part of the oven wall; being confined to about two-thirds of the height. The sole

and the crown of the oven are not subjected to more than a very moderate heat. The two end flues of the oven by which the gases of combustion pass into the recuperators can be regulated. The heating flues require only to be regulated once—when the ovens are first set in operation—and do not subsequently require more than occasional adjustment. In order to economize the heat, one of the two waste-gas flues can be throttled during the last six hours of the coking period, as it is well known that less heat is required for effecting carbonization during the latter period of coking than is necessary in the first period. A further feature of the arrangement is provision of means for diverting a portion of the hot air for consumption in the gas-producer, whereby still further economy in the heating is attained.

The great advantages of the Koppers' ovens, and the extraordinary success which the ovens have enjoyed throughout the world, led the authorities of the town of Bochum to embark upon what may appear a venturesome undertaking. The exploiting of the new system by the Bochum Gas-Works will undoubtedly be of very great advantage to the gas industry, as the experience which has been gathered together by the coke industry, and which has been jealously kept secret by individual firms, will now be available for gas-works in general. As a result, both the coke and gas industries will benefit, in that economy in cost and working and improvements in construction will all be gained through the mutual exchange of ideas. For this the Bochum authorities deserve the thanks of the community at large.

Improved Treatment of Gas Containing Ammonia.

The usual process for purification of the gases consists generally in subjecting them first of all to a cooling operation and then passing them through washers for the extraction of ammonia. The gases upon leaving the ovens pass through air and water coolers, in which the larger part of the tar and a portion of the gas liquor condenses. It is then drawn by an exhauster by which it is forced through tar extractors and ammonia washers. The ammonia washers are designed on several systems—some being of a revolving description, while others are stationary and are not mechanically operated. The principle upon which they all work, however, is the same—viz., that the washing liquor passes through the washers in the opposite direction to the gas, so that the enriched liquor comes into contact with the gas rich in ammonia, and the weak liquor acts on the gas when freed of most of its ammonia. It is necessary, in order to obtain efficient washing, for the washing liquor to be of a soft nature and quite cool.

The difficulty of constructing water-tight tanks, and of keeping them tight, and also the difficulty experienced in disposing of the effluent from sulphate works, has been the means of endeavours being made to dispense with the washing of the gases with water; and a system was brought out some years ago, the object of which was to bring the gas into direct contact with sulphuric acid, in order to extract the ammonia without the scrubbing operation being necessary. This system only required a small collecting tank for the tar extracted in the hydraulic main, which was constructed of iron. By dispensing with the necessity for the employment of water for scrubbing (the provision of which at collieries in sufficient quantity and at a sufficiently low temperature was frequently a matter of difficulty) appeared to be a great advantage. The system consisted in conveying the hot gases having a temperature from 130° to 160° C. in pipes, carefully coated with non-conducting material, and forcing the gas by means of an exhauster direct into a sulphuric acid bath. The tar separated out and floated on the surface of the acid, whence it was skimmed or drawn off. The gas not having been subjected to any cooling operation, there were no products of condensation. As a conse-

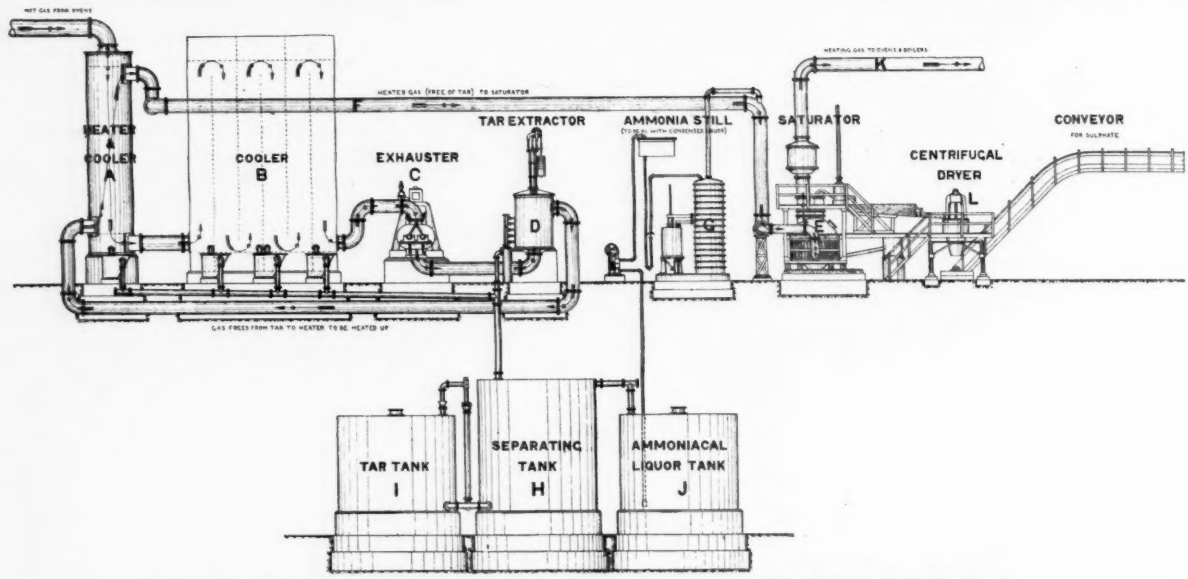


Fig. 5.—Koppers' Patent System of Bye-Product Plant for the Recovery of Sulphate Direct from the Gas.

[Gas reheated by Hot Gas from Ovens.]

quence of this, the sulphate produced was contaminated with tarry matters, which spoilt its appearance and deteriorated its quality. The tar itself was detrimentally affected, and was of an acid nature; it being necessary, in order to render it marketable, to purify it with hot water and to neutralize the acid with alkalies. It was also found that the saving in labour which was expected to be derived by the system was not realized owing to the great cost involved in producing and treating the sulphate. In order to extract the tar from the hot gas to overcome the difficulties referred to, the gases were passed through centrifugal extractors. These machines, almost without exception, possess the drawback that they extract only the constituents boiling at a high temperature, and as a result a product of a pitchy nature was produced instead of tar. This system, which has been carried out in connection with a number of coke-oven plants, has proved very unsatisfactory.

The new system of Koppers' is designed on the same principle; but in this system the gases are freed from tar before they are passed into the sulphuric acid bath. The gas is first of all cooled, in order that the tar and gas liquor may condense. It is then passed through the tar-extractor to take out the last traces of tar. After passing through the tar-extractors, the gas is led back to the preliminary gas-cooler, which is arranged as a heat exchanger and which heats up the gas to about 80° C. by the hot gases coming from the ovens. The gas heated up in this way, and freed of tar, is then conducted to the saturator, where the ammonia is extracted from the gas and recovered direct in the form of sulphate. From fig. 5 a diagrammatical representation of the system will be seen.

The hot gases of distillation pass first into what is called a heat exchanger A, and thence are conducted into water-coolers B, by which the temperature is reduced to the degree which is necessary for the extraction of tar. As in the ordinary system, the gas, after cooling, is drawn by exhausters C and forced through the tar-extractors D. After leaving the extractors, the gas is conducted to the heat exchanger A, where it becomes heated up and at the same time cools down the hot gas as it comes from the ovens. The heated gas is then taken direct to a saturator E, where it comes in direct contact with sulphuric acid. Here the ammonia is extracted, and is recovered in the form of ammonium sulphate. The gas, after being freed from ammonia, passes out of the saturator by the main K, by which it is conducted back to the ovens without necessitating any further cooling process which is necessary where the ordinary system is employed. In the preliminary cooling process a large portion of the tar and of the gas liquor is condensed out of the gas. These products of condensation are conducted to the separating tank H, from which the tar overflows into the tar-storage tank I, and the ammoniacal liquor passes into the storage tank J. The ammonia liquor is delivered to a distilling apparatus G, where the ammonia is driven off by means of steam and lime in the usual way. The vapour from the still containing the ammonia is conducted to the gas-main, whence it passes with the gas into the saturator E.

The sulphate formed in the saturator is collected in a well at the bottom, whence it is automatically removed by means of an injector, and then delivered into a centrifugal dryer F. The mother liquor extracted by the centrifugal flows into an intermediate vessel, whence it passes into the saturator. The acid is fed continuously into the saturator; and the liquor therefore is always maintained at uniform strength. The top portion of the acid in the saturator is hereby kept at a slightly acid state, which ensures the ammonia being thoroughly extracted from the gas. It

is only necessary for the gas to be heated before entry into the saturator to such a degree as will prevent condensation of the water vapour taking place in the saturator, so that the acid bath will not become diluted. The dew point of gas produced in gas-retorts is about 70° C., while in coke-oven gas the dew point is about 80° C. This is owing to the coal used in gas-works being practically free from moisture. The coal used in coke-works contains, on the other hand, a comparatively large percentage of water. It has been ascertained by actual experience that it is not necessary for the gas to be heated to a higher temperature than 80° C. before it is passed into the saturator. At this temperature it has been found that the sulphate is easily and efficiently formed. The ordinary method of producing sulphate requires the temperature of the acid bath to be maintained above 100° C. in order to prevent the steam from the still condensing in the saturator. The reduction of the temperature in the bath ensures the complete combination of the ammonia with the acid, as the lower the temperature the greater the affinity between the acid and the ammonia. At 140° C. the sulphate melts, and even at a much lower temperature it becomes decomposed.

The advantages of the new system are as follows:—

1.—A considerable saving in steam is effected, owing to the great reduction in the quantity of liquor which has to be distilled. A well-designed ammonia still requires 300 kg. of steam to treat one ton of gas liquor. The cost of steam in gas-works can be taken at 2s. per ton as a minimum.

2.—No water being required for scrubbing purposes, a saving is therefore effected in this direction.

3.—The quantity of liquor required to be distilled being greatly reduced, the effluent from the still is reduced correspondingly, which is a great advantage where difficulty is experienced in disposing of this liquid.

4.—The gas in passing through the acid bath becomes freed of all the alkaline matter it may contain. As a consequence of this, the destructive elements which are the cause of the corrosion of gas-meters, &c., are eliminated, as sulphuretted hydrogen and cyanogen combine with ammonia only in the presence of traces of alkalies.

5.—The design of the plant is very greatly simplified.

6.—The ammonia washers being dispened with, no pumps are required for dealing with the scrubber liquor. Steam is hereby saved, and also labour which would otherwise be necessary for attending to the washers.

7.—The difficulties which have frequently to be contended with in the ordinary system owing to depositions of naphthalene throughout the plant are entirely done away with, and stoppages on this account are therefore not to be feared.

8.—The heavy hydrocarbons contained in the gas are not affected in the slightest by the acid, so that no loss will be occasioned in this direction; while, furthermore, the calorific value of the gas remains unchanged.

The saving which would be derived by the new system can be taken at about 4d. per ton of coke produced. The important advantages of it are, therefore, of the greatest moment to the gas industry. Very costly appliances are dispensed with, as besides the scrubbing apparatus not being required, the liquor storage tanks can be made of much less capacity. The continual outlay for fresh water for scrubbing purposes is saved. The space required for the plant is much smaller than is necessary for the usual system, which results in considerable economy in the cost of building-work. All these advantages should appeal to town gas authorities, and induce them to introduce the new system. If only on account of the naphthalene trouble being avoided, the new plant should be viewed with favour. The new system has been carried out on a large scale for dealing with 100,000 cubic metres of gas per twenty-four hours and has proved a great success; so that its adoption would not be attended by the slightest risk.

The writer hopes that this communication will meet with the approval of gas engineers, and that it will lead to the subject being thoroughly inquired into, in which case he feels perfectly confident that it will result to the great advantage of the gas industry.

Pumping by Suction Gas Plant.—At the recent annual meeting of the Incorporated Association of Municipal and County Engineers at Nottingham, Mr. F. R. Phipps read a paper in which he dealt with the cost of pumping water by means of suction-gas plant in connection with the supply of Basingstoke. He said he opposed the adoption of electric plant; his experience at Worcester having shown that at anything like the price quoted—1½d. per unit—it would be preferable to employ gas plant. The estimated work was 340 H.P.-hours per day of nine hours; and the total figures per annum shown in his report, including capital costs, were: Steam plant, £907; electricity, £1465; and suction gas, £682. It was ultimately decided to adopt suction-gas plant. The machinery installed comprised producers, gas-engines, and pumps, all in duplicate, capable of raising 40,000 gallons per hour. The result of a 12-hours test showed a total mechanical efficiency of 64 per cent.; and in actual working over twelve months the coal per horse-power-hour worked out at 1·5 lbs., including that used for banking-up at night and other causes. The disadvantages in connection with this kind of plant for water-works were the smell arising from the gas and the care required in the disposal of the waste water from the scrubber.

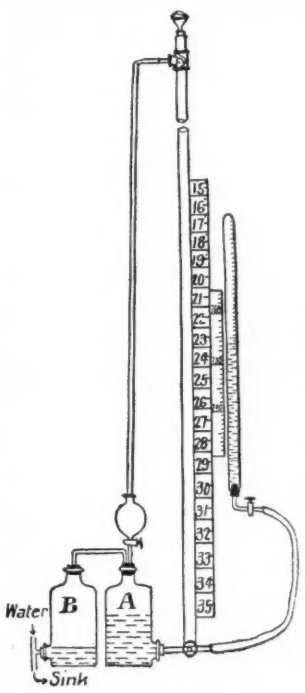
REDUCING GAS VOLUMES TO STANDARD CONDITIONS.

The Davis Apparatus.

The "American Gas Journal" reproduces from the "Journa of the American Chemical Society" a paper by Mr. GRANT T. DAVIS, of Illinois University, describing an instrument that has been devised by him for the purpose of reducing gas volumes to standard conditions.

The necessity for making a considerable number of accurate measurements of gas volumes has, the author says, led to the working out of the following device for their reduction to standard volume. Since all that is necessary for the physical reduction of a gas to standard volume is to subject it to definite pressure, a water column of variable length was first tried; but this was discarded in favour of a column of known length with a fixed scale. The length of the column of mercury (L_m) necessary to compress a gas to standard volume at temperature t is found by the formula, $V = \frac{v\,(p - p')}{760\,(1 + at)}$. The conditions being such that $v = V$, then $p = 760\,(1 + at) + p'$ and $L_m = p - 760$. The length for the water column was taken as $L_m \times 13{\cdot}59$, and correction was made for the expansion of the water with the rise in temperature.

The apparatus for use with gases which can be collected over water consists of a piece of iron pipe, about 2 metres long, fitted with a T near the top and an elbow at the lower end. The elbow is closed by a rubber stopper carrying a glass T, one arm of which is fitted with a stop-cock, and the other connected to the water supply. The T at the upper end of the pipe carries a small reservoir at the top to prevent overflow in case of too hasty filling; and the side opening is closed by a rubber stopper carrying a syphon with a very short inner leg, and the long leg emptying into the sink, or as shown in the engraving. To the lower part of the pipe is attached a scale, so graduated in degrees that the column of water from the bottom of the short leg of the syphon to the graduation is the calculated length for the temperature represented by the graduation. Attached to this "temperature" scale is a sliding "pressure" scale, whose divisions are 13·6 mm. long.



To avoid the error which would be introduced by using tap water of a temperature different from that of the room, the system of bottles A B is introduced. A contains distilled water at the room temperature. Tap water being admitted to B, the water from A is forced into the apparatus, and no temperature change occurs.

To use the apparatus, the burette containing the gas is connected to the T at the bottom of the pipe, and the stopcock is opened. Care must be taken that there is no air in the connecting tube. The graduation 760 on the pressure scale is placed opposite the point on the temperature scale which corresponds to the observed temperature; water is admitted to the pipe until the syphon begins to act; and while a slow stream continues to flow, the meniscus in the burette is brought level with the graduation of the pressure scale which corresponds to the observed barometric pressure, and the corrected volume of the gas is read off. The position represented in the figure is that for a gas observed at a temperature of 21·4°, and a barometric pressure of 754 mm.

Table A gives the length of water column necessary to compress a gas to the standard volume for temperatures from 15° to 34°C. Table B offers a comparison between the standard volume as calculated, and as observed by means of this instrument.

TABLE A.

T.	cm.	T.	cm.
15	73·9	25	126·9
16	79·2	26	132·7
17	84·0	27	138·7
18	89·2	28	144·4
19	94·2	29	150·7
20	99·5	30	157·0
21	104·8	31	163·3
22	110·2	32	169·8
23	115·8	33	176·7
24	121·2	34	183·4

TABLE B.

p.	t.	v.	(Cal.) V.	(Obs.)
750·5	20·6	42·0	37·64	37·7
750·5	21·4	41·6	37·13	37·1
742·1	26·2	41·9	36·11	36·1
742·1	26·5	31·6	27·16	27·1
741·2	26·0	30·6	26·33	26·3
733·2	21·1	74·0	64·58	64·5
736·4	22·6	6·2	·5·39	5·4
748·4	19·0	50·2	45·20	45·2
760·5	18·5	49·6	45·51	45·4
760·0	21·0	41·7	37·77	38·8

NORTH BRITISH ASSOCIATION OF GAS MANAGERS.

Annual Meeting in Edinburgh.

[From Our Own Correspondent.]

Affiliation with the Institution of Gas Engineers has not crippled the North British Association of Gas Managers in any of its energies. Nobody outside of Scotland expected that it would; and in Scotland itself the feeling was more intense than widespread. The step having been taken, it is found that the men of the Northern Kingdom have still something left upon which they can entertain and instruct themselves—and a great many more than themselves. Their meeting in Edinburgh last Thursday was subject to two drawbacks. In the first place, the Association had, in the course of the year, lost by death the services of their Secretary—Mr. Robert S. Carlow, of Perth—and were thus deprived of the guiding hand which had been at the helm for 21 years; though it is fair to Mr. Lawrence Hislop, of Uddingston, his successor, to say that, in the circumstances, he made a very efficient substitute. Then the meeting was held without the presence of leading members of the Association, who were in attendance at the parliamentary inquiry into the Edinburgh Provisional Order, which opened the same day. But with these disadvantages, a meeting was pulled through which the Association have every reason to look upon with satisfaction, and to take credit for. Mr. William Blair, of Helensburgh, discharged the duties of President with his accustomed geniality. He did not detain the meeting with a long address, and thereby allowed the technical business to be reached promptly.

In this part of the programme two items of considerable interest emerged, both of which were connected with the supply of gas under pressure to outlying districts. Mr. J. D. Keillor, of Lochgelly, described how he has successfully supplied gas to three adjoining villages, through the existing main, only of 4 inches diameter, and extending to a distance of 1¼ miles. The system of pressure raising and governing down is not new, but its application in Scotland to the supply of a district is; and to members of the Association the value of the communication lay in the fact that they heard from the lips of one of themselves his description of how the service was accomplished, the saving it had effected, and the success which had attended it—that success being a very large addition to the roll of consumers, as reflected in the rise in the consumption of gas in one year from 10 to 18 million cubic feet. The figures just given show that Lochgelly is not a large place; and it is this fact which gives the arrangement its chief attraction to gas managers in Scotland, where so many of the works are small. What has been done in Lochgelly may be accomplished elsewhere. There are many towns in the country which have populous places adjoining, and to which, in some cases, gas is supplied in a way, but only in a way, because of the inadequacy of the mains, but to which, by the use of higher pressures, it would be possible to give a supply satisfactory for all purposes. There are such districts, too, which are not provided with gas, because of the prohibitive cost of laying to them a main of adequate capacity. By the application of high-pressure distribution, these should come within the scope of possible lighting areas, to the benefit of the owners of the nearest gas-works. Mr. Waddell, of Dunfermline, brought under the notice of the meeting a scheme of high-pressure supply to Limekilns and Charlestown, about three miles distant, and in all probability it will be extended ultimately to the naval station at Rosyth. Mr. Waddell was troubled over the economical control of the supply at the distance. He, however, hit upon the device of laying inside the high-pressure main a small pipe, to bring back to the works the reduced pressure at the far end; and this is used for regulating the steam power which drives the compressor. By these simple means, the supply at a place several miles distant is controlled. Mr. Waddell's communication was most favourably received, as it deserved to be. Mr. R. Cowie, of Lockerbie, gave an account of the uphill work which has been accomplished by the Corporation there in connection with the gas undertaking, for the carrying on of which it has been necessary to impose a contingent guarantee rate since 1892. The task of raising the undertaking from its sinking condition to one of prosperity is now all but accomplished, thanks to wise advice and good management; and Mr. Cowie's story, simple though it be, is worth perusal.

The Association had—an unusual experience—scarcely any administrative work to perform. Negotiations are still going on for the publication of the papers upon technical subjects contributed by the late Mr. William Young, of Peebles, to the Association and otherwise, but not much progress was made during the past year. The subject has been left in the hands of the Committee with instructions; and it is hoped something more definite will be reported to the meeting next year. Mr. J. D. Smith, of Stirling, has been appointed President; and, as already mentioned, the new Secretary and Treasurer is Mr. Lawrence Hislop, of Uddingston.

The Forty-Seventh Annual Meeting of the Association was held in the Masonic Hall, George Street, Edinburgh, last Thursday, under the presidency of Mr. William Blair, of Helensburgh. There was a good attendance.

The President, in opening the proceedings, expressed his pleasure at seeing his fellow-members present in such numbers.

Apologies for unavoidable absence were intimated from Mr. W. R. Herring, of Edinburgh, Mr. G. R. Hislop, of Paisley, Mr. W. Ewing, of Greenock, and Mr. J. W. Napier, of Alloa.

Report of the Committee.

Mr. L. Hislop, of Uddingston, the Interim Secretary, read the report of the Committee. It was stated therein that the Benevolent Fund had been drawn upon during the year to the extent of £10, one deserving case having been dealt with by the Committee. No question of great importance on any special subject, in regard to either the manufacture or the distribution of gas, had been brought under notice for consideration. The Committee's duties, therefore, had in that respect been of a very light nature during the year. In accordance with the resolution unanimously passed at the last general meeting, the Association had now been affiliated with the Institution of Gas Engineers, and a large number of the members had joined the Institution. Any others desirous of joining could do so before the 30th of September next without any entrance fee. Two Commercial Sections had been formed under the auspices of the Association. The Western District section had a membership of 42, that of the Eastern District comprised 32 members. As a result of the working of these sections, the prices of residuals had been well maintained during the year; while many other matters had been dealt with for the benefit of the members. The Committee recommended that the Statistical Report, which had been compiled annually for a number of years, should be abolished. The Committee had had under consideration various suggested alterations to the rules, &c.; and they recommended that the whole rules and regulations of the Association should receive reconsideration. The Committee recommended that Mr. W. Doig Gibb, President of the Institution of Gas Engineers for the year 1907-8, should be made an honorary member of the Association. The Committee had considered the publication of the late Mr. Young's papers; but no definite arrangement had been come to.

New Members.

The Committee recommended that the following gentlemen be admitted as members:—

Ordinary Members.—George Bruce, Holytown; William Easson, Jedburgh; Francis Lechie, Motherwell; James Mitchell, Ardrossan; William Peacock, Shotts; Hubert Pooley, Stafford; J. A. Robertson, Polmont; W. A. Smith, Hawick; David Small, Largo; J. J. Scott, Kennoway; A. B. Walker, Walker-on-Tyne; Thos. Watson, Girvan.

Extraordinary Member.—George Hands, London.

Associate Members.—Dugald Currie, Stirling; A. R. Wilson, Perth; R. B. Lechie, Motherwell.

The following members were removed by death during the year: Mr. R. S. Carlow, Perth; Mr. John King, Bo'ness; Mr. John M'Gilchrist, Gourock; Mr. George Taylor, Jedburgh; Mr. W. M'Giffin, Wick; and Mr. Robert Laidlaw, Glasgow.

The roll of the Association now stands as follows: Ordinary members, 164; extraordinary members, 61; associate members, 16; and honorary members, 4—total, 245.

Mr. J. Whyte (Seaham Harbour), as a neighbour of Mr. W. Doig Gibb, said he had great pleasure in moving his election as an honorary member of the Association.

Mr. J. W. Carmichael (Barrhead) seconded the motion; and it was carried unanimously.

The Statistical Report.

The President said, in connection with the Committee's recommendation as to the Statistical Report, that information had been supplied to the Secretary in a very dilatory fashion in past

years; and it was considered at two or three meetings of the Committee whether it would be advisable to revise the report or do away with it altogether. The Committee had had the subject under consideration just before the meeting, and thought they should lay it before the members, to see whether they would wish the report continued or revised. To his mind it would be a pity if the report were done away with, especially in the interests of small gas managers. He would certainly like to see it continued, if they could have information at an early date, so that the Secretary could get it compiled. He did not see why this could not be done within a month or six weeks. If the members would take the matter to heart, he thought the Statistical Report should be continued. He had found great benefit from it himself, and he was sure many other managers had done the same.

Mr. D. Vass (Airdrie) suggested that the question should be included in the remit to the Committee as to the revision of the rules, and that for the present year they should continue the report as formerly. He moved that the report of the Committee should be adopted, and that the subject of the continuation of the Statistical Report should be referred to them.

The President said this was the opinion come to by the Committee at a recent meeting; but they thought it well to give the report as submitted, so as to bring the matter before the members, and afford an opportunity of urging the advisability of sending in the reports and returns promptly, so as to lighten the work of the Secretary. Mr. Hislop had gone into the matter of cost, and had told him that to compile the reports involved an outlay of from £25 to £30, apart from the cost of the report of proceedings.

Mr. W. B. M'Lusky (Perth) thought they should not discontinue the issue of the Statistical Report. He suggested that they should revert to their former method of reporting the proceedings. He considered that, from a literary point of view, the reports of the proceedings in the "Journal of Gas Lighting" were superior to those compiled by themselves. There was a great deal of extraneous matter contained in their own reports which was of no interest at all. The Technical Press took away the unnecessary verbiage, and left the essential parts of discussions; and these were quite enough. If they reverted to the old method of reporting, they could quite well afford to continue the Statistical Report, and have the valuable information it contained.

Mr. C. P. Myers (Troon) seconded the motion; and it was agreed to.

Publication of Mr. Young's Papers.

The Secretary read a letter upon this subject which had been received from Mr. J. Gordon Mason, S.S.C., the Law Agent for the late Mr. William Young's Trustees. It was stated therein that Dr. Daniell had prepared a complete bibliographical index of all Mr. Young's contributions to technological literature, from the beginning to the end, with a note as to the length of each item, which should certainly break the back of the task of preparing the papers for publication, whoever might take the work in hand. The writer asked if anything further were being done by the Association. It was also suggested that it might be advisable to include in the publication Mr. Young's papers upon oil-works practice and shale retorts.

The President said it was satisfactory to know that the matter was still under consideration, and that it was looking brighter and more hopeful. He trusted that in the near future they would have Mr. Young's papers reprinted in book form. He would put it to them, as an Association, whether they were prepared to bear any expense in connection with the publication of the papers, or whether they should go further in the matter. Very little had been done with their Research Fund; and if they took any money from it for the purpose in question, it would be practically using it for research work.

Mr. Myers asked if there was any idea of the probable cost of the publication.

The Secretary said he understood that Dr. Daniell, for the editing of the work, would charge merely his own outlay; so that the expense would only be this item and the printing of the book. If a sufficient number of copies were taken, the expense to the Association might be very trifling; but if there were not a large number sold, the expense would be proportionately heavier upon the Research Fund, or whatever fund the money was taken from. There would have to be a guarantee as to the number of copies to be taken before the work was sent to the printer. The Institution of Gas Engineers, and also the Oil-Works Association, might purchase a number of copies; so that the expense to the Association would not be so very large.

The President said the Committee would like to have the opinions of the members as to whether they were to proceed, even if the work required £50 or £100. He thought that, if it were actually needed, £100 out of the Research Fund could not be spent in a better way.

Mr. Whyte considered it would be a very great pity if such valuable contributions as Mr. Young's should be lost to the Association for a matter of £50, and he would urge that the Committee should go forward, even if it cost more than this.

Mr. Vass seconded the motion to this effect.

Mr. J. Napier Myers (Saltcoats) moved as an amendment that the expenditure should be restricted to 25 guineas. While he was anxious to see Mr. Young's papers published, he did not think they should deplete the Research Fund to any greater extent than the amount he had named.

Mr. S. B. Langlands (Glasgow) suggested that the Secretary should send out circulars to the members, and in this way ascertain to what extent the book would be taken up.

The Secretary said the members were very dilatory in sending in replies to circulars; and for this reason he thought it would be hardly worth while to adopt the suggestion. If he sent out 300 circulars, he never received more than 60 or 70 replies.

Mr. A. Waddell (Dunfermline) remarked that Mr. Young's membership of the Association was an honour to them. They could not think of anyone whose contributions equalled his; and he (Mr. Waddell) should not like to limit the amount spent on their publication. He thought the Association should go forward and have the papers printed.

Mr. D. Macfie (Edinburgh) pointed out that there was no estimate before the members as to the cost of the book; and therefore if the Committee had authority to spend £25 in preliminary arrangements, this should, in his opinion, be sufficient. They could afterwards come to the members for further powers, and get more money, if necessary.

The President considered that, if the members were willing to spend £25, it would be a pity that the matter should be thrown over for the sake of another £25.

Mr. S. Milne (Aberdeen) said it appeared to him that £25 was a mere bagatelle. He should not be surprised to learn that the amount would be as much as £200 or £300. Would it not be nearer their purpose to leave the matter still in the hands of the Committee? Perhaps by another year there might be something definite brought forward. The Committee might then be in a position to say that they had within their power the acquisition of the papers, and that the printing would cost a certain amount. He proposed that the matter be still left in the hands of the Committee.

This was agreed to; it being understood that the Committee are to be at liberty to expend whatever is necessary to enable them to acquire the manuscripts.

The Auditor's Report.

The Auditor (Mr. R. B. Main, of Glasgow) submitted his report. He said he had much pleasure in congratulating the Committee on the satisfactory financial results of their operations. They had a total increase, roughly, of £60. Their funds amounted to £634 15s. 6d., against £575 18s. 10d. He should like to congratulate the Association upon having a Secretary like Mr. Hislop, who took over the books at considerable disadvantage, and had a great deal to learn. He was pleased to find that not a single mistake had been made in the accounts.

The President thought it said a very great deal for the Secretary that they had so favourable a report from the Auditor, to whom he had much pleasure in moving a vote of thanks.

The motion was carried unanimously.

PRESIDENTIAL ADDRESS.

The President then delivered his Inaugural Address, in the course of which (after thanking the members for the honour they had done him in electing him President) he said: It is my sad and painful duty to record the deaths during the past year of Mr. John King, of Bo'ness, Mr. Geo. Taylor, of Jedburgh, Mr. R. S. Carlow, our late Secretary, and Mr. John M'Gilchrist, of Gourock. Mr. King was a quiet, unassuming man, and highly esteemed by those who came in contact with him. He always took a lively interest in all matters appertaining to the manufacture and distribution of gas. Mr. Taylor was, perhaps, better known to the members of the Waverley Association, for which he acted as Hon. Secretary for many years, during which time he did much to further the Association's interests. Any reference that I can make to the memory of Mr. Carlow may be considered superfluous, as, during the 21 years he was Secretary of the Association, he was known, beloved, and respected by all. We were all sorry to see him looking so ill at our meeting last year; and we earnestly hoped he would recover. But that was not to be; and we mourn the loss of an energetic and able servant of the Association, and a genial colleague. Mr. Carlow's whole heart was in the work of the secretaryship of the Association; and no detail of that work was too trifling to receive his personal attention. As he himself was fond of saying, the work to him was a labour of love; and as such he performed it. I am sure that the sympathy of all of us goes forth to Mrs. Carlow and the family in their great loss. Mr. John M'Gilchrist was a young man of great promise. It is a painful coincidence that Mr. Carlow and Mr. M'Gilchrist (whose families were for many years on terms of the closest friendship) should die on the same day, and within a few hours of each other.

After many years of controversy, affiliation has at last been accomplished with the Institution of Gas Engineers; and as time rolls on, much good may accrue therefrom—especially in parliamentary and research work. All the Sectional Associations are now affiliated to the Institution; and, for the first time, we have a Central Institution truly representative of the great gas industry, whether that industry be in the hands of companies or of local authorities. As one result of the affiliation of this Association with the Institution, no fewer than twenty Scottish gas managers joined the Institution at the annual meeting last month. Under the affiliation scheme, the Association are entitled to be represented on the Council of the Institution by one of their members. During the past year we have been so represented by our worthy Past-President, Mr. Lawrence Hislop. At the last meeting of the Institution, Mr. Hislop was elected an ordinary

member of the Council; and now it falls to this meeting to nominate someone to take his place on the Council as the direct representative of the Association.

At our last annual meeting it was decided to form a Commercial Section representative of the Association. Since then, monthly meetings of the section have been held; and, as you have heard from Mr. Hislop, who has ably acted as Secretary of the section, many matters have been discussed of great importance to the members and to the corporations and companies whom they represent. I trust that the Commercial Section will be more strongly represented by the members in the coming year. There are many matters of great importance to the undertakings which we respectively represent that can be discussed privately at the meetings of the Commercial Section which cannot be raised at our public annual meeting; and even if they could be discussed at the annual meeting, the discussion would often be so belated that it would be of little practical use to any of us. The object of the Commercial Section is to afford opportunity for comparing notes and statistics in regard to that section of our business which is concerned with outside parties, and to afford these opportunities at the right moment, when a comparison of opinions and experiences is likely to be of the most value to the undertakings we represent. I think, therefore, there can be no two opinions as to the value of the work the Commercial Section is doing; and, as I have already said, I hope to see it better supported in the future.

Along with many members of the Institution of Gas Engineers, I accepted the kind invitation of the German Association of Gas and Water Engineers, and visited Berlin last month. We were handsomely entertained by our hosts and by the Imperial Continental Gas Association. I was very much impressed with all that was shown to us—more especially with the Bueb vertical retorts, to inspect which was the special object of the visit to Berlin. I am convinced that much will yet be heard of this system of carbonization. When it is remembered that coal is carbonized in these retorts in charges of 10 or 12 cwt., which are burned off in from ten to twelve hours, yielding something like 14,000 cubic feet of gas per ton, it will be realized that the labour needed for working a plant is reduced to a minimum—especially when it is borne in mind that the retorts are both charged and discharged by gravity. It is true that the candle power of the gas produced is not very high; but anyone who has seen the magnificent street lighting by gas in Berlin, will admit at once that high candle power is not everything. With a gas of low and uniform candle power (somewhere about 12 candles) and a uniform heating power (something like 550 B.Th.U.), all the requirements of the Berlin gas consumers are thoroughly well satisfied; and I have not yet seen anything to beat the incandescent street lighting there. In saying this, I mean no disrespect to the magnificent lighting of the Edinburgh Exhibition, arranged by our Past-President, Mr. W. R. Herring, which you will have an opportunity of inspecting, if you have not already done so.

The Woodall-Duckham process of continuous carbonization in vertical retorts, which has been in experimental operation at Bournemouth and elsewhere, is very fascinating, and has many admirers; while Mr. G. R. Love's retorts inclined at an angle of 45° seem to be giving a good account of themselves. By the way, it is interesting to note that Mr. Love is one of the many successful gas engineers who received their first training in that excellent school, the Paisley Gas-Works, at the hands of our friend Mr. George R. Hislop. In this connection, the work of our late esteemed friend Mr. William Young cannot be forgotten. Mr. Young showed how to distil shale in vertical retorts for the production of oil and ammonia; and now his (at one time) fellow workers Mr. Samuel Glover and Mr. Thomas Glover are adapting his ideas to the carbonization of coal for the production of illuminating gas. Very soon, I believe, a complete plant on these lines will be at work at St. Helens. Nor will it be forgotten that our immediate Past-President, Mr. Lawrence Hislop, successfully carbonized coal at the Uddingston Gas-Works in coke-oven chambers, and only, I believe, gave it up because the particular coal used was no longer available.

The gas engineering profession is much indebted for the vast amount of valuable information which has been freely published during the past few years on this important subject. The vertical retort has, I think, now got beyond the experimental stage; and we are likely to see installations in some form or other adopted in Scotland in the near future. Though not adapted to the smallest works, because the units—at present, at all events—are too large, the system is quite within the reach of any moderate-sized works.

The increased demand for gas for cooking and industrial purposes necessitates a higher day pressure. Incandescent lighting also requires a higher night pressure than formerly. These higher pressures are being maintained without any increase in the percentage of unaccounted-for gas. In Helensburgh, where the day and night pressures have been increased, we have a lower percentage of unaccounted-for gas than in former years; the average being about 90,000 cubic feet per mile of main, with a sale of over 1,000,000 feet per mile of main.

As I serve a gas corporation, the matter does not affect me personally, but the position of gas companies in regard to the opening of streets and roads for the purpose of laying or repairing pipes is one of some doubt and difficulty. It is not for me to discuss the rights and the wrongs of the matter; but I was a little surprised to find, on looking into the figures, that of nearly two hundred gas companies in Scotland, only five have statutory authority to carry on operations. Of course, many of these are so small that they can scarcely aspire, under any circumstances, to obtain an Act of Parliament or a Provisional Order. Still, if parliamentary authority could be secured for a less outlay of money than at present, no doubt there are many gas companies in Scotland who would be willing to put themselves on a better footing than they seem now to be on in regard to the disturbance of the surface of the roads. It is to be hoped that the Board of Trade (Provisional Orders) Bill that has just been introduced in Parliament may afford some relief in this respect.

Despite keen competition on every side, increased sales of gas are being reported in almost every town. The metallic filament lamps of the electricians have lowered the cost of light to the consumer; but the incandescent gas burner and mantle have not stood still, with the result that gas is more than holding its place as the cheapest illuminant for our public streets, our business premises, and our homes. The magnificent exhibit of the gas undertakings of the United Kingdom at the Franco-British Exhibition is a fine illustration of what the home can be made by the proper use of gas-cookers, gas-fires, and gas-burners; while the outdoor lighting, both at the Franco-British Exhibition and the Scottish National Exhibition, is proof of the excellence of gas for street lighting. Everybody who has to do with the direction or management of our gas undertakings should make it a point to see one or other of these displays—both, if possible. It will put more heart into them than any words of mine can.

It is not my intention to weary you with a long address. The number of Associations, Senior and Junior, now in active operation, gives so many opportunities for addresses and papers that I may be obliging you—I am certainly consulting my own taste—if I cut my remarks short. But before closing, I would like to say how pleased we all are with the good work done by the Junior Associations. By the interchange of opinions and experiences at their periodical meetings, the juniors are acquiring knowledge and confidence that will assist them when the time comes for them to fill the places of those who are now their seniors, if not always in technical knowledge, at least in age and experience.

Mr. J. D. Smith (Stirling) moved a vote of thanks to the President for his address; and it was carried.

The Papers.

The reading of the papers was then proceeded with. They were as follows: "High-Pressure Distribution," by Mr. J. D. Keillor, of Lochgelly; "A Few Notes on High-Pressure Gas Supply," by Mr. A. Waddell, of Dunfermline; and "The Financial Difficulties of a Small Municipal Gas-Works," by Mr. R. W. Cowie, of Lockerbie. The first two, with a report of the discussions upon them, will appear next week. Mr. Cowie's paper, and the remarks it called forth, appears to-day (p. 251).

Thanks to Authors of Papers.

Mr. J. W. Carmichael (Barrhead) proposed a hearty vote of thanks to the authors of the papers Personally, he had not had any experience of high pressure; but the papers brought before the members by Mr. Keillor and Mr. Waddell had made them all think as to whether they could not adopt it in their towns. He was pleased indeed to see two of their younger friends giving them papers; and he had been much interested in all they had had to say. He hoped others would come forward and give them the results of their experiences.

Election of Office-Bearers.

The President intimated that, as the result of the ballot, the following gentlemen were elected office-bearers for the year:—

President.—Mr. J. D. Smith, of Stirling.
Vice-Presidents.—Mr. A. Waddell, of Dunfermline; and Mr. G. Keillor, of Broughty Ferry.
Secretary and Treasurer.—Mr. L. Hislop, of Uddingston.
Auditor.—Mr. R. B. Main, of Glasgow.
Members of Committee.—Mr. J. M'Leod, of Kirkintilloch; Mr. Allan Reid, of Brechin; and Mr. T. O'Neill, of Dunbar.

A letter from Mr. Charles Fairweather, of Kilmarnock, was read, in which he expressed regret that he could not give the time necessary to the business of the Association, and tendered his resignation as a member of the Committee. This having been accepted, it was necessary to elect three members to the Committee instead of two.

Place of Next Meeting.

It was decided that the meeting next year should be held in Stirling.

Closing Proceedings.

Mr. Smith returned thanks for his appointment as President, and proposed a vote of thanks to the Secretary.

Mr. Hislop briefly acknowledged the vote, and then, in his capacity of Past-President, presented Mr. Blair, whom he described as one of the oldest members of the Association, with the President's Medal.

The President returned thanks, and mentioned that he would hand the medal down to probably the fourth generation in the direct line of gas managers.

This concluded the proceedings.

DINNER AND VISITS.

The members and friends, including a large proportion of ladies, subsequently dined together in the Balmoral Hotel; the company numbering upwards of 120. Mr. Blair presided. The toast of "The North British Association of Gas Managers" was responded to by the Chairman, who claimed that the Association was now in a healthier condition than it had been for the last sixteen or seventeen years.

On Friday, a large party of the members paid a visit to the New Grange Meter-Works of Messrs. Alder and Mackay. They were received by Mr. J. Hutton and Mr. Alex. Mackenzie, who extended a cordial welcome to them. The visitors were shown round the works, and afterwards went on to the Scottish National Exhibition in the neighbourhood. A photograph of the party was taken, and afterwards a company of about 130 partook of luncheon in the Prince's Restaurant, under the presidency of Mr. Blair. The toast of "The Chairman" was proposed by Mr. W. Prince, of Stoke-upon-Trent. The only other toast was that of "The Secretary," proposed by Mr. Mackenzie. After luncheon, the party separated, and spent the afternoon and evening in the Exhibition. Excellent weather favoured the visit.

THE MITCHELITE PETROL AIR-GAS APPARATUS

Of late years there has been a considerable amount of attention devoted to the improvement of plant for the production of air-gas; and it must be admitted that a measure of success has been achieved that a few years since would have been voted impossible. The crude air-gas methods of years not long ago had ridicule heaped upon them; but the same criticism cannot be levelled against the modern plants. These plants have to be accepted as practicable and economical methods of obtaining a supply of gas for situations where an ordinary gas supply is not available; and such situations comprise a very large field. The modern air-gas plants have their merits; and, when required, choice has to be made between them on such points as relative efficiency, cost of installation, and working expense. A certain efficiency having been attained, the struggle of inventors has been to secure greater simplification at a reduced cost, to remove the causes of objection that have been discovered, and to endeavour to place the plant generally beyond reproach. Mr. Ernest G. Mitchell, the Secretary of the Laddite Incandescent Mantle Company, Limited, of Audrey House, Ely Place, E.C., invited us recently to inspect a new petrol air-gas apparatus (Harsant's patent), which has become his property; and it may be said at once, and without qualification, that it is impossible to conceive of a plant for this purpose with more commendable features, and certainly it is a plant in which objections to older forms of apparatus are absent. No engine or blower is required; no winding-up of weights or holder for the storage of the gas is needed; and the petrol has not to be stored in any free liquid form. While greater simplicity has been achieved, safety, constancy, and reliability have been ensured, and the operating parts have been reduced to such a state of simplicity that wear and tear has been reduced to the minimum point—and all this without any sacrifice of the efficiency claimed by more complicated predecessors.

The operative power of the plant is merely the water pressure of the ordinary house water service; and the quantity of water used is the merest dribble—the water pressure only being automatically brought into service at a rate and at times governed solely by the utilization of the gas. The installation seen was situated in a room in which incandescent burners supplied by the gas were being employed, and numbered with several round the garden some two dozen burners, though the plant was capable of serving 150 lights. A $\frac{3}{8}$-inch pipe connected the plant up with the house water-service; the outlet-pipe leading to a drain proved, when all the lights were being used, only a waste of little more than a trickle. This 150-light plant occupied a space measuring 4 ft. 9 in. high by 4 ft. 6 in. by 2 feet. The plant consists of three vessels—the water-operated air-compressor, the air-receiver, and the carburettor. To obtain gas, the carburettor (which is not an ordinary petrol reservoir as will be seen presently) having been charged, all that has to be done is to turn the water-tap situated on top of the so-called pump, and no further attention need be paid to the plant. The main body of the pump is a cylindrical outer casing, containing a water-sealed bell. The only mechanism is at top near the water-tap; and it consists merely of an ingenious rotary disc valve, which is the seat of the simplicity of the plant. This valve contains four port-holes—two for supply and two for exhaust. The valve is operated by the ordinary water pressure, which opens and closes the port-holes. The absence of an ordinary water service by the way is no bar to the use of the plant; but that is a point to which we need not devote consideration here. The action of the valve exerts pressure on the bell below, and air is driven through a valve in the bottom of the pump into the adjoining air-storage vessel, which is also a cylindrical container, with a water-sealed bell. It is interesting to notice that, as the air-receiver bell descends, the bell of the pump ascends, accumulating a charge of air to force into the air reservoir as required. By the simultaneous action, the air is driven from the reservoir at the bottom, and is carried by a pipe to the top of the carburettor and then through it to the bottom, where it is liberated for carburation by the petrol vapours.

The carburettor is an interesting feature of the plant. It is fitted with twenty discs (the number and thickness can be varied according to requirement), about $1\frac{1}{2}$ inches thick, composed of absorbent materials, which soak up the petrol, and give off its vapour to the air on its zig-zag travel through the carburettor. In the carburettor there is safety, as the petrol is not free, but is all occluded in the discs. Of course, the period of recharging the carburettor, which will absorb 2 gallons and more of petrol, and still more if a larger number of discs be used, is determined by the extent of the demand for the gas. Any unabsorbed petrol is drawn off by a tap at the bottom of the carburettor. The whole cycle of gas production being automatically performed, the gas passes straight away to the points of use. The question of condensation was inquired into; and an experiment last winter with outside lighting, through 200 feet run of gas piping, showed at the end of the period that the pipes (although exposed) were perfectly dry and clear, without the slightest trace of deposit.

The apparatus is so arranged that the proportion of the mixture is about $98\frac{1}{2}$ per cent. of air to $1\frac{1}{2}$ per cent. of petrol vapour; and the character of the flame is shown by a simple experiment in the flame of an ordinary "C" burner with copper wire. The melting-point of copper is 1943° Fahr.; and a copper wire was melted in about the space of a minute. The gas can be used not only for lighting, but for cooking and heating, but not in flat-flame burners, as the flame is not luminous. For lighting it was seen in use with ordinary "C" and Kern No. 2 burners, as well as with inverted burners; but, with gas composed of such a large proportion of air, the ordinary air-inlets had to be almost completely closed. As to illuminating power, a No. 2 Kern burner gives a light of from 50 to 60 candles, with a consumption of gas somewhat below that of a "C" burner giving equal light. A point noticed was that no matter the number of lights in use from one upwards, there was no variation of illumination as the number was increased and then diminished, which indicated the constancy of pressure through the automatic regulation under all conditions of demand. In the room, too, in which the demonstration was made, there was no perceptible vitiation of the air, and though some of the lights were within 2 feet from the ceiling, it was perfectly clean. From a fairly considerable experience with the plant, Mr. Mitchell places the cost of the gas at 1s. 3d. per 1000 cubic feet.

If we sum up the points particularly favourable to the plant that suggested themselves from the investigation, they are: Simplicity, automatic working, no complication, comparatively low cost of installation and running expenses, low wear and tear, small claim for attention, compactness, safety, reliability, absence of liquid petrol and gas storage, and constancy of pressure. The plant (which is made in sizes suitable for any demand—small or large) is also being adapted for high-pressure lighting.

Prize Winners in the Gas Examinations.

We have received from the Superintendent of the Department of Technology of the City and Guilds of London Institute a list of the prize winners at the last examinations. The following are the names of the successful candidates in the "gas" subjects:—

Gas Engineering.

Honours Grade—First prize (£3 and a silver medal), Harold Harrocks, Manchester.

Ordinary Grade—First prize (£2 10s. and a bronze medal), Arthur Robert Griggs, Regent Street Polytechnic, London; second prize (£1 10s. and a bronze medal), Edward George Stewart, Portsmouth; third prize (a bronze medal), Hugh E. Roberts, Carnarvon.

Gas Supply.

Honours Grade—First prize (£3 and a silver medal), Charles F. W. Rendle, Truro.

Ordinary Grade—First prize (£2 10s. and a bronze medal), Edward George Stewart, Portsmouth; second prize (£1 10s. and a bronze medal), Eric Stanley Durward, London; third prize (a bronze medal), Harold E. Morgan, London.

The money prizes are given by the Goldsmiths' Company; the medals by the Institute. It will be noticed that one candidate—Mr. Stewart—is a prize winner in both subjects. We congratulate him and all the other students on their success. Their further progress will be watched with interest.

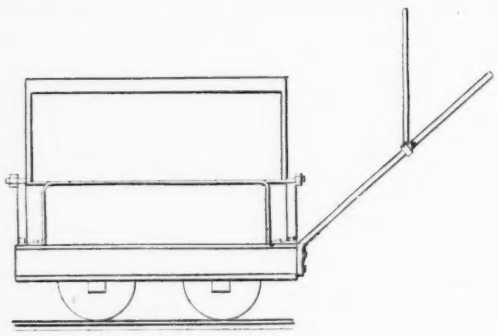
We are pleased to learn that Mr. J. H. Willoughby has been appointed Manager of the gas-works at Santos, Brazil. Mr. Willoughby received his early technical training at the Science and Art Schools of Leamington and Coventry; and he holds many Queen's prizes and advanced certificates in Science and Art, and also in the ordinary and honours grade in "Gas Manufacture." He has been associated all his business life with the gas-works at Leamington—having received his early training under the late Manager, Mr. W. Cross, and acted during the past ten years as first Assistant to the present Engineer and Manager, Mr. Thomas Berridge, under whose instructions he has had charge of various alterations and improvements that have taken place from time to time. Mr. Willoughby's great interest in anything relating to the gas profession is known to those who follow the proceedings of the Midland Junior Gas Engineering Association, in the meetings of which he has always taken an active part. We feel assured that it will be a matter of regret, no less to Mr. Willoughby than to the other members, that he will be unable to attend future meetings of the Association.

A TIP HOT-COKE BARROW.

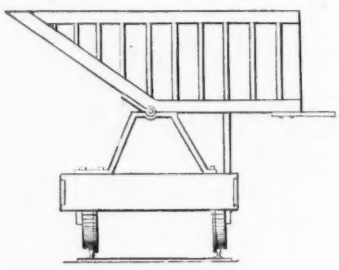
By M. Paul Coze.

[Abstract of a Paper read before the Société Technique du Gaz.]

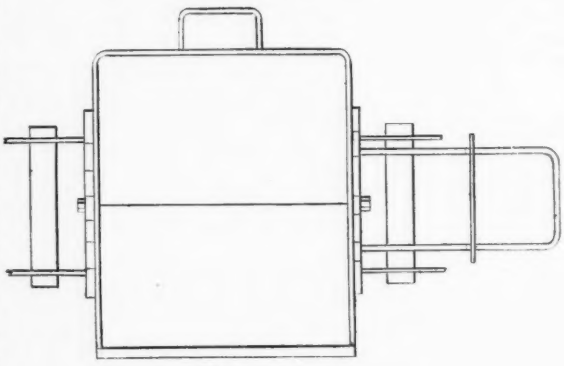
M. Kemler, of the Cateau Gas-Works, has designed a special coke-barrow, so as to simplify and to facilitate the labour of carrying away hot coke from the retort-house to the yard. It is of the Decauville, or tip-waggon type, and necessitates a narrow gauge track. But its essential difference is in the form of the barrow. This will be seen in the accompanying drawings.



Side Elevation.

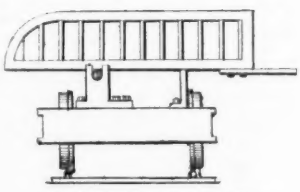


End Elevation.



Plan.

Tip Coke-Barrow for Upper Tier of Retorts.



Small Tip Coke-Barrow for Bottom Tier of Retorts.

It is made of 4 millimetre (nearly $\frac{3}{16}$-inch) plate; three of its sides having open ribs, while the fourth is inclined and free for the discharge of the coke. The barrow rests on a longitudinal axle, and is carried at each end by a turned V-shaped support. It is balanced on the axle, so that, when full, a very slight effort on a handle at the side overturns it. The handles for pushing the barrow are of round iron, and at an angle of 45 degrees. Upon them is fixed a shield to keep off the heat of the coke. At present, two sizes of barrows are required—one for the upper tiers of retorts and the other for the bottom retorts. For the latter, the barrow is much lower; the same capacity being obtained by increasing the bottom surface of it. The tipping of it is not complete as with the other; but it is hoped to combine the two types into one model by altering the swing of the larger barrow.

The net cost of the barrow described, made at the works, is 40 to 50 frs. (32s. to 40s.); and it lasts from five to six years.

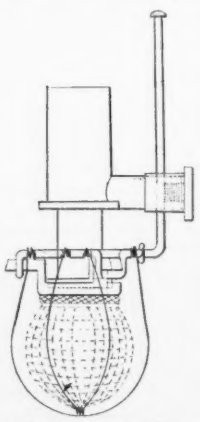
USE OF COMPRESSED COAL GAS FOR RAILWAY CARRIAGE LIGHTING.

At the recent meeting of the Société Technique du Gaz en France, a paper on the subject of the lighting of railway carriages by compressed coal gas was read by M. Defoy, one of the Engineers, under M. Gaston Gautier, at the Havre station of the European Gas Company. It was, in a sense, a supplementary paper to the one read at the congress of the Society at Havre in 1905 by M. Naudé, another of the Engineers at that station; and it was submitted with the view of bringing before the members the latest particulars as to the extension of the compressed gas system of lighting carriages by the Western of France Railway.

The author began by reminding the members that it was upon the initiative of M. Chapsal, the Chief Engineer of the Railway Company, supported by M. Gaston Gautier, that the installation of the first compressing station was decided upon. The plant, which was put up in the gas-works at Havre, consisted of a Douane compressor, capable of dealing with about 880 cubic feet of gas per hour at 48 lbs. pressure, worked by a 7-H.P. gas-engine. The installation was an object of interest to the members on the occasion of the congress referred to. The trials having been in every way satisfactory, the Railway Company at once decided to adopt generally the compressed gas system of lighting. Two stations, which were described and illustrated in M. Naudé's communication, were fitted up at Clichy so as to serve the St. Lazare Terminus. They each contained three compressors of twice the capacity of the one at Havre. Since then five additional stations—at Montparnasse and the Invalides in Paris, and at Caen, Le Mans, and Rennes—have been brought into use; and the original station at Havre is to be superseded by a larger one.

The two Paris stations have each two compressors, equal together to about 3500 cubic feet of gas per hour, actuated electrically by continuous current at 110 volts. The Caen, Le Mans, and Rennes stations have each two compressors of the size of that at Havre, driven electrically—at Caen by three-phase current at 110 volts, at Le Mans by continuous current at 240 volts, and at Rennes by current obtained from the tramway at 500 volts. With regard to the enlarged station at Havre, which will comprise three compressors, each equal to 1765 cubic feet per hour (though only two will be put up at first), the power will be furnished by electric motors of 15-H.P., supplied with continuous current at 110 volts. The plant is located in an electricity generating station specially erected in view of the adoption of the mechanical conveyance of coal and coke by the De Brouwer system. All the compressors are of the same type as the original one; and they possess the following features: Diameters of cylinders—large 8·8 inches, small 3·2 inches; piston stroke, 8 inches; speed, 180 revolutions per minute; horse power, 12·5. Accompanying the paper were diagrams showing the arrangements of the several stations; and particulars were given of the electrical equipment, as well as some extracts from the instructions issued for the guidance of the employees at the compressing stations.

In connection with this extension of high-pressure gas lighting, a new inverted burner has been devised by M. Claude, the Company's Chief Lighting Engineer, who has endeavoured to obtain a firm attachment of the mantle—experience having proved that by rigidity of suspension its life is prolonged. The new arrangement is shown in the accompanying illustration. The Company's rolling stock comprises about 4600 coaches, of which 2300 are lighted by compressed coal gas by means of 11,000 burners. The system is being extended, and it will be complete in about two years. The coaches remaining to be fitted with the improved lighting are those used for the "omnibus" trains, which have fewer burners than the 2300 already mentioned. From their transformation, however, will result a considerable increase in in the consumption of gas by the Company, which last year reached rather more than 43½ million cubic feet. The Southern Company have adopted lighting by coal gas with inverted burners, and are extending the system. The Northern Company will shortly bring into use, by way of trial, on their suburban trains, a number of gas-lighted coaches; a compressing station now being constructed at their terminus in Paris.



The Claude Inverted Burner.

In conclusion, the author expressed his acknowledgments to M. Chapsal for the particulars he had been able to lay before his colleagues, some of whom might, he thought, possibly be called upon to assist in fitting up an installation of gas-compressing plant for use in connection with the lighting of railway carriages.

Mr. Alex. Lobban, the Manager of the Auchterarder Gas Company, died recently, at the age of 33 years, after a painful and lingering illness. Mr. Lobban was a native of Kinross, where his father was Gas Manager. He had been two years at Auchterarder, prior to which he was Manager at Comrie.

The death has occurred, in his thirty-second year, of Mr. Alfred Meakin, of Wolstanton, head of the firm of Messrs. A. Meakin, Limited, earthenware and tile manufacturers, of Tunstall. Deceased was one of the pioneers of the use of gas for firing potters' ovens; the process having, as the result of careful experiments, been introduced at his different works, both for the ovens and the enamel kilns.

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Sölingen	30	Potsdam	48
Ludwigshafen	30	Berlin—Oberspree	48
Zürich	100	Berlin—Mariendorf	84
Düsseldorf	70	Berlin—Tegel	10
Offenbach	80	Chemnitz	60
Brandenburg a/H.	60	Worms	30
Trieste	20	Potsdam (Repeat Order)	40
Elberfeld	120	Mariendorf (Repeat Order)	72
Frankfort—Bockenheim	120	Charlottenburg	70
Genoa	60	City of Berlin—Danzigerstrasse	240
Magdeburg	80	City of Berlin—Schmargendorf	80

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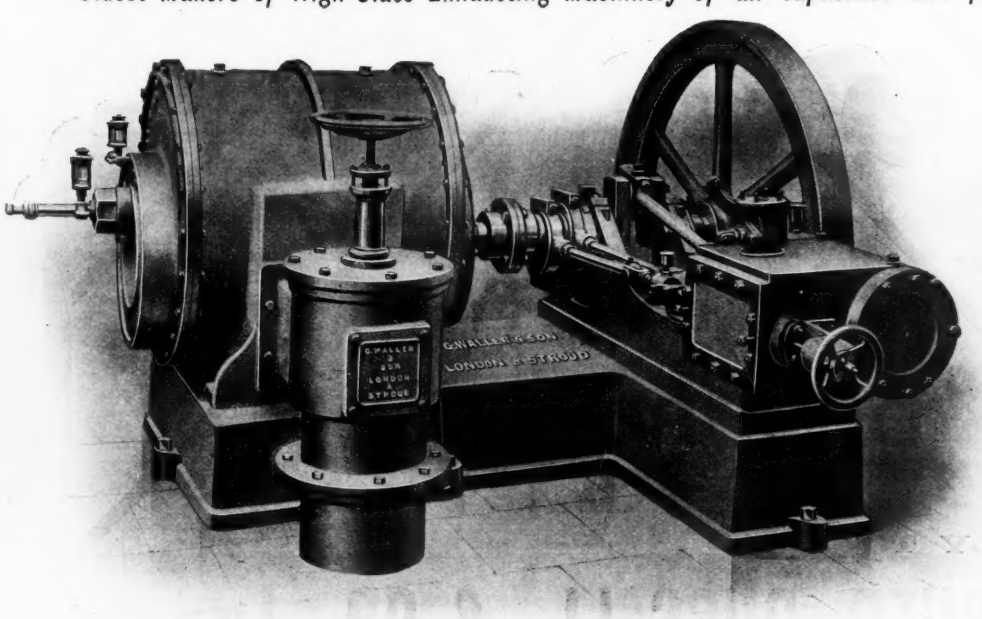

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THE DESIGN AND CONSTRUCTION OF IMPOUNDING RESERVOIRS.

By Wm. Watts, M.Inst.C.E., F.G.S.

[A Paper read before the Association of Water Engineers.]

In the following paper, the author has endeavoured to epitomize some of his experience extending over a period of forty years, including the construction of eighteen reservoirs for the water supplies of large corporations, and of a number of smaller ones for private firms.

Embankment.

The batters given to the inner and outer slopes of a reservoir embankment are fixed by general agreement, and seldom vary from 3 to 1 on the inner, and 2½ to 1 on the outer, unless the nature of the material used demands flatter slopes. In designing the outer slope, however, regard must be paid to the height to which the embankment has to be raised and the hydrostatic pressure of the water in the reservoir. Benches or terraces are usually introduced in the case of deep embankments; and, where judiciously placed, they add stability and a pleasing appearance to the structure, and also afford access from one side of the valley to the other, which is often a convenience. They have, however, the disadvantage of retaining snow and excess of moisture which is dangerous if allowed to remain in the earthy material of a deep embankment. In the author's opinion, the contour of the outer slope should be designed in a parabolic curve. A slope of this kind requires more care in setting out; but the strength and weight of the material are better adjusted to resist the static pressure than is the case when the outer slopes are benched. The simplest arrangement is, however, a slope of 4 to 1 to a reasonable height from the base, then increased to 3 to 1, and finished at 2 to 1 at the top-bank level. An inner slope of 3 to 1 is most satisfactory in every way. It is not too abrupt for the waves to beat against, and will support shingling or pitching without any tendency to slide down. Moreover, it affords a foothold for the workmen while they are laying the pitching.

In setting-out an embankment, the centre line of the longitudinal section should be used as the base-line from which all measurements and offsets should be taken; and the centre line and top-water level should be permanently fixed at the outset. To insure well-formed slopes, profiles should be fixed one chain apart at right angles to the centre line, and firmly fixed in the ground at the foot of both the inner and outer slopes. After the slope-boards have been fixed, the main outline of the embankment plan should be cut out in the grass floor to clearly define it. All soil and soft material within the defined base should be removed and the necessary draining and benching proceeded with. The extent to which this preliminary work should be carried out depends upon the character of the foundation and the height to which the embankment is to be raised. Too much care cannot be taken in preparing and laying dry the base, which should be packed with rubble stone some distance inwards from the toe of each slope. The extent to which stone can be used for this purpose depends upon the quantity obtainable near to the works at a reasonable cost and suitable in quality.

When the foundation of the embankment has been satisfactorily drained and benched, the concrete or puddle trench may be proceeded with. All the hard and stony material removed from the excavations should be placed in convenient layers at the foot of the outside slopes within the embankment—preference being given to the outer half. The material used for the base of an embankment is governed by the nature and amount of the excavation removed from the trench and discharge tunnel. The stronger and heavier material should be placed within reasonable distance of the trench; leaving room for the more adhesive earthwork to be placed next the puddle, as backing. Indiscriminate tipping should be avoided as much as possible.

Trench Excavation and Formation of Earth Embankment.

In all cases the author prefers concrete for refilling trenches below the ground level where strata are hard and permeable. Concrete-filled trenches are safer and cheaper, and, if properly managed, are sooner opened out and refilled than puddle trenches. There is no difficulty in making narrow concrete cores water-tight if proper care is taken in mixing, manipulating, and depositing the aggregate in position. The embankments carried out under the direct supervision of the author in the Little Don Valley for the City of Sheffield have an average depth of 94 feet and 72 feet; and both have proved watertight. The deeper trench has a head of water exceeding 100 feet from the drawing-off level, and the shallower has a head of 54 feet. While the central trench is being opened out, the discharge tunnel should be driven in the solid at whichever end of the embankment has been proved to be the soundest stratigraphically; and the foundation of the valve-well should also be prepared and built at the time the tunnel lining is proceeding. The excavations from these sections of the works should be placed permanently in the embankment in a position suitable to the nature of the materials, or, if there proves to be an excess of stony material not required for draining the embankment, it should be run on one side for use at a later stage for concrete or other purposes. Too much stone, however, cannot be employed in the foundation if only it be carefully selected and placed; but it is too valuable for use where earthwork would be equally satisfactory.

To avoid delays and inconvenience in the execution of the works generally, each section should be well thought out in advance, so as to follow on progressively and permanently. Where there is no flood watercourse to carry the floods past the works during construction, the discharge or outlet tunnel should be commenced and made ready to pass the whole of the water from the drainage area before the refilling of the trench is commenced. Unless this be done, there is danger of the open cutting across the valley getting flooded and partially silted up, and the works seriously damaged. The author knows from experience what an anxious time it is when, during the opening and refilling of the trenches, the works are placed at the mercy of relentless floods which no human agency can control. Where embankments control drainage areas, a permanent flood-water course should be provided, to collect the river water at the head of the reservoir. This is available for all time, and has the great advantage that flood water can be diverted from the reservoir and separated from the normal flow of the stream. In a long reservoir, the cost of constructing such a water-course is heavy; but the possibility of controlling and separating the flood water more than justifies the extra cost.

Where watercourses are not provided, larger discharge tunnels have to be built to pass the floods occurring while the works are in progress. In the Little Don Valley, which had a drainage area of 8698 acres, the discharge tunnel was 14 feet in diameter, having a sectional area of 159 feet; and yet this tunnel was fully charged on three occasions during the progress of the works. The extent of this provision for flood-water is well illustrated by the fact that the pipes permanently regulating the delivery of water from the reservoir had an area of only 16 feet. An opening as large as this, unless well built, constitutes a permanent weakness in any embankment. The Act for the construction of these works was, however, obtained before the author was appointed Engineer, or he would have constructed a flood-water course and a 6 feet discharge tunnel which would then have been sufficient. The outlet tunnel being completed, and the refilling of the trench well advanced, the excavations should be commenced and the embankment proceeded with.

As previously stated, the outer slopes should be formed of the strongest material and kept in advance of the more central part of the embankment until completion.

Although some engineers are opposed to removing material from the inside of the reservoir for the formation of the embankment, the author has generally adopted this plan with success, and does not see any objection to it, if the impervious character of the trench is satisfactory and it is carefully tied into the valley slopes at both ends. The excavation should be made on the side slopes of the reservoir site as far away from the embankment as the physical features of the ground will permit; and it is advisable to take them from the upper levels, and thereby enlarge the actual working capacity of the reservoir, rather than from the lower levels to which the water is seldom reduced. River gravels, being heavy and quickly drained, are very suitable, and make good foundations for the waggon roads until the embankment has attained a height of about 12 feet. The upper reaches from which the excavations have been removed should be beached or pitched to protect the ground from the action of the waves in windy weather, and also to prevent discoloration of the water, particularly near the decanting outlets. Indeed, it

TABLE *showing Particulars of the Water Supplies of Various Towns compared in* 1902.

——	SHEFFIELD.	OLDHAM.	MANCHESTER. (Longdendale.)	BRADFORD.	BOLTON.	HALIFAX.
Population supplied	425,845	223,000	1,100,000	450,000	273,000	224,933
Drainage area—acres	15,703	4,470	19,300	40,370	3,325	5,000
Storage capacity of reservoirs—gallons	3,687,000,000	1,976,000,000	6,006,000,000	4,732,000,000	1,157,000,000	1,346,000,000
Average daily supply—gallons	11,215,081	5,250,000	32,000,000	13,000,000	6,000,000	5,250,000
Gallons stored per acre of drainage area	234,796	442,058	311,191	117,215	347,970	269,200
People supplied per acre of drainage area	27·1	49·9	57·0	11·1	82·1	45·00
Gallons stored for each person supplied	8,658	8,861	5,460	10,515	4,238	5,983
Gallons supplied daily per acre of drainage area	714	1,174	1,658	322	1,801	1,050
Average daily supply—gallons per head	26·3	23·5	29·1	28·9	22·00	23 3
Average annual rainfall—inches	40·52	40·5	49·16	42·00	50 33	46·65

——	WAKEFIELD.	BLACKBURN.	SWANSEA.	PLYMOUTH.	ROCHDALE.	BATLEY.
Population supplied	140,000	130,000	110,000	107,509	100,000	30,321
Drainage area—acres	2,737	6,000	2,476	5,360	2,400	1,597
Storage capacity of reservoirs—gallons	818,000,000	410,000,000	512,000,000	657,000,000	613,000,000	231,000,000
Average daily supply—gallons	2,600,000	4,000,000	3,224,000	6,000,000	2,000,000	1,400,000
Gallons stored per acre of drainage area	298,860	68,333	206,785	122,574	255,417	144,645
People supplied per acre of drainage area	51·1	21·7	44·4	20·0	41·7	19·0
Gallons stored for each person supplied	5,843	3,154	4,654	6,111	6,130	7,618
Gallons supplied daily per acre of drainage area	950	667	1,302	1,119	833	876
Average daily supply—gallons per head	18·6	30·7	29·3	55·8	20·00	46·1
Average annual rainfall—inches	45·00	50·00	53·18	51·57	50·00	59·04

NOTE.—The whole of the above works supply on the gravitation principle; and the calculations are made from a common basis. The Thirlmere works, however, are not included in the table for Manchester; while the population is stated as if attached to the Longdendale source of supply only.

is an advantage to shingle the reservoir slopes all round unless the alluvium is stony and will in time shingle itself. There is no harm in removing clay from the reservoir site, as the water-tight character of the reservoir depends on the nature of the strata in the trench, and not on that of the submerged area.

The earthwork for the middle and the outer slopes of the embankment requires to be carefully selected to ensure good work; and the clay existing on the site of the reservoir should be turned over to ensure a good blend by mixing the stronger with the weaker qualities. Clay puddle is much improved by casting, breaking up, and watering, and is also mellowed by age, which also makes it easier to work. Soil and clay which are too weak for puddle should be reserved for backing the inner side of the puddle wall, where it should be spread in convenient layers as the work proceeds. Valley clay, usually found in thin beds or layers, is decomposed shale, having some of the aluminous particles washed out of it by atmospheric exposure; and where this is the only material available, the width of the puddle wall should be increased proportionately.

In the Pennine Valleys and similar districts, the author does not favour the construction of concrete dams in lieu of earthen embankments. The weight in such designs is too concentrated for foundations of rock and shale, often different in structure and texture. In variable or doubtful strata, two shallow reservoirs should be constructed rather than one deep one. Beyond finding room in the embankment for the excavation from the main trench and discharge tunnel, it is not wise to proceed with the embankment until the puddle wall has been raised to the surface level—10 feet to 12 feet above the finished level of the concrete core.

The refilling of the trench being completed, the embankment should be proceeded with at once; the material being tipped from waggons in layers not exceeding 3 feet thick. In dry weather, each layer should be carefully watered, to ensure solidity; water being the best agent in making earthwork solid. The embankments at Langsett and Underbank were built in this way; the former absorbing nearly 900,000 cubic yards of earth and puddle, and the latter 350,000 cubic yards. To allow for settlement, each of these embankments is cambered 18 inches in the centre. After nearly three years service, the Langsett embankment settled 4 inches only in the centre under a head of 120 feet of water. In the pitching on the inner slope, it is better not to course the stones from end to end, but to break-joint and finish off the top with a curve, which has a pleasing effect, affords a deeper storm wall, and acts as a check to the spray in stormy weather.

The overflow and byewash should be solidly built of good masonry, and the weir of sufficient width to pass a maximum flood with not more than 18 inches depth of water when the top bank level is 7 feet above, and 12 inches where the top bank is not more than 5 feet above. A sufficient gradient should be provided to allow the water to pass freely away. The side walls and squared pitching should be made perfectly sound and watertight, and the bye-wash sufficiently deep to prevent the water overflowing them at times of large floods.

The late Sir Robert Rawlinson expressed the opinion that waste weirs should be made 3 feet wide for every 100 acres of drainage; but as this statement takes no account of the physical features of the watershed and the depth of the weir below the top bank level, such a rule must be regarded as arbitrary and empirical. Although the enlargement of a weir is not a serious item of cost, it is much better to be on the safe side. At Langsett, the waste weir is 200 feet wide for a drainage area of 5203 acres; and at Underbank is 250 feet wide for an area of 8698 acres. The ratio is not the same in both instances, because in the latter case the crest of the drainage is two miles farther away. The annual rainfall is also less; and there are three reservoirs to modify the effects of floods before they are felt at Underbank.

GENERAL CONSIDERATIONS.

The extent of the drainage area, taken in connection with the ascertained average annual rainfall, are the factors which determine the amount of storage capacity that should be provided in order to fully utilize the yield of any drainage area. Thus, a watershed yielding an average of 48 inches of rainfall should have a storage capacity provided of not less than 65,000 cubic feet per acre; and if the general inclination is steep and the underlying rock is impervious, a capacity of 70,000 cubic feet per acre is not too much.

The average annual rainfall in the principal valleys of the country has been recorded for many years past; but it is necessary to obtain maximum readings in each case, and measure the rate at which water flows off the watershed under various rates of rainfall. The accompanying table, giving the rainfall and other information with regard to reservoirs owned by some of the larger corporations, shows the disparity which exists in this respect, and emphasizes the necessity for greater care being exercised in the designing of works in order to store and utilize the rainfall to the best effect. The data on which the table is based were obtained in 1902; but with some modification of little importance, it is applicable at the present time and suffices to confirm the author's opinion that it should be made compulsory by Statute that the whole of the rainfall derived from such areas should be fully made use of within reasonable limits, and the surplus supplies, which would otherwise be wasted, handed over to other corporate bodies.

This subject deserves more than passing notice, both in the public interest and that of the Corporations owning the various works, as the more important drainage areas in the country are being rapidly taken up by larger water authorities, to the exclusion of many smaller ones.

It is impossible to prepare a comparative statement of the cost of works in general, owing to the dissimilarity in the designs, depth of trenches, character of work, variations in the physical features of the localities in which the works are placed, availability of suitable structural material, and other

kindred matters. The following figures, have, however, been obtained from printed and other sources, and are reproduced in the hope that any errors may be pointed out in the discussion. The Walshaw Dean reservoirs for the Halifax Corporation cost £468 15s. per million gallons; the Swansea reservoir cost £550 per million gallons; two embankments at Rooden, for Oldham, cost £490 11s. 4d. per million gallons; the Swinshaw reservoirs for Ashton-under-Lyne and Stalybridge have cost £405 per million gallons; the new scheme proposed for Monmouth by Mr. Baldwin Latham is estimated to cost about £322 per million gallons. The Sheffield works, recently constructed by the author, have cost £485 8s. 9d. per million gallons storage; but this cost includes, besides parliamentary expenses, large payments for compensation water and other matters. Dealing with these works from a structural point of view only, the cost per million gallons is barely £210, including the screening chamber, clear-water well, distributing reservoir, 33-inch mains 12 miles in length, waterman's residences—two residences are built, one at each embankment—tram-line and new road diversions, and many minor items, such as estate improvements, village water supply, &c., not usually included in this class of estimates.

Discussion.

Mr. C. H. Priestley (Cardiff) said, in the first place, he noticed Mr. Watts wrote that, in the case of deep embankments, judiciously placed benches were an advantage, and that they also afforded access from one side of the valley to the other. But it was rather dangerous to put the bench half-way down the embankment. Would it not be better to put it at the top of the embankment than at a lower place? In connection with the concrete shoe at the bottom of the puddle trench, Mr. Watts stated that it was better to have these concrete shoes. He (Mr. Priestley) quite agreed with him in this particular. But it appeared to him the kind of shoe referred to here was very much below the ordinary ground-level; and he should be glad if the author would state the distance below ground-level. He learned that the bottom portion of the shoe was of cement concrete, and the top portion of lias lime concrete. Why were two materials used; and what was their respective cost per yard? Presumably the lias lime concrete was placed there to economize. The author also stated that concrete-filled trenches were safer and cheaper, and, if properly managed, were sooner opened out and refilled than puddle trenches. He (Mr. Priestley) did not quite follow what Mr. Watts meant by being opened out and refilled. Did it mean a second opening out, or the first opening out? Then the author advised that where embankments controlled drainage areas, a permanent flood-water course should be provided to collect river water at the head of the reservoir. He agreed with the author here to a certain extent; but in many cases the cost of the flood-water course prohibited its use. If Mr. Watts could give the members some idea of the cost of the flood-water course (say, per yard run), he should be obliged. It was also stated in the paper that, in the Little Don Valley, the discharge tunnel was 14 feet in diameter, and had a sectional area of 159 feet—that was for a drainage area of some 8700 acres. Would not the proportion of waste weir to the drainage area depend to a very great extent on the rainfall of a district as well as on its acreage? He was reminded here of Sir Robert Rawlinson's formula, after records had been taken in eight different parts of the country, and the differences ascertained between maximum and minimum rainfall. On their own area at Cardiff, they had 52 inches minimum, and 117 inches maximum, which was very considerable. He rather disagreed with Mr. Watts on the question of the pugging of clay. He said it was improved by casting, breaking up, and watering. Was not that the object of having the clay pugged; and probably it was better dealt with in a pugging-mill than by hand work. He believed, in the case of the Staines reservoirs, the whole of the puddle was passed through a pugging-mill. There was a matter referred to in the paper that was of the greatest importance to the country generally—that was, the allocation of drainage areas to certain large towns and districts. He (Mr. Priestley) did think that the time had come when the Government should give attention to this matter. In many recent Acts, provision had been made for the supply to smaller districts along the line of conduit; and this should be absolutely the case in every large works constructed in future.

Mr. F. W. Hodson, M.Inst.C.E. (Loughborough), said he should like in the first place to refer to the author's statement that it was preferable to fill the trench with concrete rather than puddle. In this connection, there was one point upon which he should like a little information from the author—that was, as to what he considered a reasonable minimum thickness for the concrete to enable it to be made water-tight, in view of the many joints necessary in the large area of thin wall due to the daily interruptions of the work. He remembered seeing on the large masonry dam at Stockport (the foundations of which were not satisfactory) that a very deep curtain trench had been carried down, he believed, to a depth of over 100 feet below the main foundation level, which, to the casual observer, seemed to be so narrow that one could hardly expect that all the various joints, as the trench came to be filled with concrete, could possibly be absolutely water-tight under the heavy pressure entailed. Mr. Watts advocated in the earlier portion of his paper the construction of a long channel to permanently divert the flood water to waste. This was rather the opposite to what he advocated in the latter part of the paper—that it should be made compulsory by Statute that reservoirs should be made of an extremely large size for the purpose of conserving the whole of the water. With respect to the preparation of the clay puddle, he had very much sympathy with Mr. Watts's views, and preferred, with him, hand cutting, casting up, and watering, to the use of a pug-mill. The object of the pug-mill was no doubt the same; and the result was apparently gained much quicker. But in the proper preparation of clay puddle, "time was the essence of the contract." The essential treatment of clay puddle to make it suitable for thoroughly water-tight work was ageing or weathering; and no machine method of treatment could replace this. Simply putting the material into a pug-mill, and then into the trench straight away would only make puddle in the exceptional case where the material used was a fat, buttery surface clay, which had been naturally weathered *in situ*. He was also pleased to see that the author did not favour concrete dams, in lieu of earthen embankments. He (Mr. Hodson) was very much of the same opinion. There were proper positions for both; but there had unfortunately been in this country a wave of fashion with regard to the construction of masonry dams, whether or not the sites were suitable for the purpose. The essential condition for the construction of masonry dams was an absolutely homogeneous and rigid foundation; and there should be no layers of materials of various degrees of hardness in the area of the foundation. The foundation trench of the Stockport dam disclosed the latter conditions; and it was therefore an unsuitable position for the construction of a masonry dam. Part of the foundation was of layers of stone, interleaved, at an angle, with layers of very much softer shale several feet in thickness. One could not, under such conditions, obtain an even pressure on the foundations; and it was therefore a great risk to undertake the construction of a concrete dam under such circumstances. He should very much like to know upon what basis Mr. Watts gave them the figure of 65,000 cubic feet per acre as being the proper amount of storage for 48 inches of rainfall. It appeared to him (Mr. Hodson) that an apparently empirical figure of this nature would not favour the truest economy in the construction of the reservoir which was just suited to the particular site. The correct size depended upon the rainfall, the evaporation, the nature of the slopes, the geological character of the watershed, and the part of the country in which it was situated. One should ascertain the flow of the stream by actual gaugings, and construct a diagram; and thereby get the actual capacity required. But he did not think he could agree that it should be upon the average rainfall, as Mr. Watts had suggested, because the average rainfall—the true mean—was made up of thirty years' figures; and if one was to be compelled by Statute to make a reservoir equilibrate the water of the thirty years, so as to supply towards the end of the thirty years excess rainfall which had fallen in the earlier portion of the period, there was no doubt that both customers and ratepayers would have good reason to be up in arms against a Statute dealing with the subject in such a way.

Mr. R. Askwith (Bishop Auckland) said he noticed the author stated that, "although some engineers were opposed to removing material from the inside of the reservoir for the formation of the embankment, the author had generally adopted this plan with success, and did not see any objection to it;" and, again, later on, he remarked "there is no harm in removing clay from the reservoir site, as the water-tight character of the reservoir depends on the nature of the strata

in the trench, and not on that of the submerged area." This must depend upon the nature of the material in the valley generally. There were valleys of rocky formation which had on the face a deposit washed down from the hills. If this deposit was removed, the rocky face would be opened up, and the water allowed to go through into an adjoining valley. When the water went underground, it did not follow the same course as on the surface, but went into the crevices of the rock that had been opened up, and travelled according to the lie of the rock, and would find its way out in adjoining valleys. It seemed to him (Mr. Askwith) to be a very serious matter to remove from the surface of the ground a deposit that had been placed there, and which probably was almost, if not altogether, water-tight, and secured the water-tightness of the reservoir. With reference to puddle, he should like to ask whether the soil and clay that were too weak to be used for puddle, should not be reserved for backing the outer as well as the inner side of the puddle wall. There was a point in connection with pugging that had not been mentioned. Where they had clay with small stones in it of a sandstone nature, if the clay was pugged, the small stones were broken up, and the clay weakened for puddling purposes, because the coarser grains of broken stone got mixed with the finer material; and it did not remain as good a puddle as before. He looked upon pugging as a dangerous practice.

Mr. Antony Lees (Birmingham) remarked that, in view of the visit of the members to the Elan Valley works of the Birmingham Corporation, it occurred to him that perhaps some figures bearing on the last paragraph of the paper would be of interest. The works at the Elan Valley—the reservoirs, the valve-tower, the filter-beds, and, in point of fact, the works to the beginning of the aqueduct—worked out on the present available storage at £160 14s. per million gallons. Looking at the scheme as a whole, including the entire aqueduct, the works viewed the previous day at Frankley, and the distribution mains conveying the water into the city, worked out on the storage at £513 8s. per million gallons. It was to be remembered, however, that in the latter figure were included the purchase of the gathering ground, which would serve to supply additional reservoirs having a capacity of 6640 million gallons. The price also included the cost of the whole of the tunnels and the cut-and-cover work constructed for the delivery of three times the quantity of water which would at present be taken. The works at Frankley, and the distribution mains into the city, were constructed for half of the entire yield.

The President: The figure you have given applies to the ultimate gathering ground?

Mr. Lees: The ultimate gathering ground is acquired, and is included in the second figure, which applies to the storage capacity provided at the present time.

Mr. William Matthews (London) observed that he should like to point out what appeared to him as a probable error of some sort in the figures given at the conclusion of the paper. Mr. Watts said the Sheffield works recently constructed had cost £485 8s. 9d. per million gallons storage, including certain things. Then later on, he said dealing with these works from a structural point of view only, the cost, including many things beyond the reservoir, was only £210. The greater sum must include the less.

Mr. H. Ashton Hill (South Staffordshire Water Company) suggested that the paper might have been entitled "The Design and Construction of Reservoirs with Earthen Embankments;" it would have facilitated reference to the paper in future. It was advisable on this question of cost to always bear in mind just what one was speaking about in alluding (say) to £200 or £300 per million gallons for storage or impounding reservoirs, and to say what were the costs included in the comparisons.

Mr. C. Clemesha Smith (Wakefield) said Mr. Watts stated that, in the Pennine Valleys and similar districts, he did not favour the construction of concrete dams in lieu of earthen embankments. That was rather a broad statement; and he (Mr. Smith) agreed with Mr. Hodson that of late years masonry dams had been fashionable; and in some instances, masonry dams had been constructed where earthen embankments would have been better. He knew of valleys in the Pennine Chain where masonry embankments were much more suitable than earthen embankments. Where they had a narrow gorge, with a bed of rock 50 or 60 feet deep below the stream level and rock ends, the site would probably be more suitable for a masonry embankment than an earthen one. The statement in the paper was too general, and wanted some qualifying. With reference to the filling of trenches, no doubt in the cases that had come under Mr. Watts's charge, concrete had been the best material with which to fill them; but there were cases where it would be better, more reliable, and cheaper to use puddle. The best engineer adapted himself to the circumstances in which he was placed. They could imagine circumstances where stone was difficult to get, and where the necessary labour sufficiently reliable to trust with concrete, could not be readily obtained. In cases like this, providing clay of satisfactory quality was at hand, it must be better to use puddle. With reference to the table, it seemed to him that Mr. Watts's figures of 65,000 and 70,000 cubic feet of storage capacity per acre with 48 inches of rainfall were somewhat high. It appeared to work out to over 200 days' storage of the total yield of the gathering ground, and that was above the usual limit. In the case of his (Mr. Smith's) own works, the whole of the reservoirs originally contemplated were not yet constructed. This would account for the discrepancy in the gallons stored per acre; and therefore, on that account, the figures were not strictly comparable.

Mr. Watts observed that he was reminded the time was short, and so he would answer the main questions in writing. There was just one point he should like to immediately deal with, and which seemed to have touched the minds of two or three speakers—that was, with reference to the gallons stored per acre of drainage. If the members would refer to the table he had prepared, it would be seen that Oldham stood at the head of all others with respect to the storage per acre of drainage. He had something to do there in suggesting that the storage capacity should be increased. He was told many times that the rainfall would not be sufficient to fill the reservoirs. Since the reservoirs were enlarged, however, they had been filled, and had given the borough an increased storage. Of course, he should not recommend 65,000 to 70,000 cubic feet per acre in a district where there were only 21 inches of rainfall. That would be a suicidal thing to do. One word regarding Mr. Hodson's reference to the discharge tunnel. It was made sufficiently large to deal with the maximum flood, and had nothing to do with the watercourse. If a watercourse had been put down, the culvert would only have been 6 feet in diameter—just sufficiently large to cover the pipes to protect them. Since the meeting, Mr. Watts has completed his reply to the discussion, as follows: In reply to Mr. Priestley, it must be observed that benches are not substituted roadways, but intended to strengthen any deep embankments. They offer facilities, however, for getting soil on the slopes during construction, and also for harvesting the hay grown upon them. The central concrete trench should not be carried into the valley alluvium likely to be affected by pressure of the embankment, but stop short in unyielding ground where widening for the concrete shoulder takes place and the puddle wall begins. Where the shoulder or shoe begins to widen out from 6 feet to 12 or 14 feet, hydraulic lime concrete is recommended on economical grounds only. Cement costs 42s. per ton, and hydraulic lime 16s.; so that the saving in the proportion of 5 to 1 in the former, and 4 to 1 in the latter, is considerable. As an impervious material, lime concrete is fully equal to cement-made concrete; and placed in the position named, compressive strain only comes into operation as the shoulders are widened out in supporting rock on both sides of the trench. "Opening-out" means excavating the trench; and "refilling," placing concrete in the cutting to form the impervious central core. It is evident that a trench 6 feet wide is sooner opened-out than a trench 12 feet wide made for puddle; and it certainly costs very much less, and claims other advantages. Watercourses constructed to control the floods flowing from a large drainage area are a decided advantage, not only during the construction of the reservoir embankments, but for the maintenance ever after, and especially in separating the floods from the normal flow of moorland streams. I have made eleven of them to preside over eleven reservoirs, and know their advantages. It is regrettable to see highly discoloured flood water pouring into a full reservoir, and forcing clean water over the weir-crest. Moorland streams in their normal state are often sufficiently pure to require no filtration, if kept out of the reservoir, and passed into a well previous to entering the supply main. The cost per lineal yard depends on the size and character of the work put in. The excavations, in the main, may be brought into the embankment, if engineers would get rid of the idea that it is unwise to begin the formation before the trench is refilled to the surface of the ground, and brought up with it. The rainfall and acreage have both been taken

into consideration in designing the waste weir at Underbank 250 feet wide, so that a maximum flood from 8868 acres shall not exceed 18 inches deep over the weir-crest, which is 7 feet below top-bank level. The eighteen reservoir embankments which I have made for Major Blackburne, M.Inst.C.E., for Messrs. Bateman and Hill, and on my own responsibility, have been made in the Pennine Valleys, in the worst of ground. But in no case has pugging the clay been considered necessary; and all the embankments are water-tight. If clay be required the consistency of butter, by all means pug it; but it is not improved. Moorland clay turned over in the clay field, the larger stones picked out, moistened and aged, is greatly improved—and pugging cannot further improve it—and costs less per cubic yard. In reply to Mr. Hodson, I do not clearly understand his question. The minimum thickness of a core of concrete intended to resist the pressure of water depends on the static head, and how it is made and placed in position. I am not aware of any satisfactory experiments having been carried out to test the piercing properties, under varying heads of water, of concrete made in cement and lime. The clear-water well in the Little Don Valley, 13 feet deep, is absolutely water-tight on an unrendered floor 9 inches thick, made of 5 to 1 cement concrete; and at Oldham I have built a supply-tank 15 feet deep, with 9-inch side walls—lime concrete, supported by rubble in mortar—which have been also water-tight these last sixteen years. The floor of this receptacle is 6 inches lime concrete, and rendered, placed on a layer of broken stones. To what extent a minimum thickness may be fixed, greatly depends how the work is done and the quality of the material used. I do not understand what Mr. Hodson means by the "many joints necessary in the large area of thin wall due to the daily interruptions of the work." When concrete is placed in position, it should not be interrupted in setting; and I have no knowledge of joints appearing in my concrete. If he refers to joints in the natural strata, the concrete is put in to cover them and to make them water-tight. Mr. Hodson is confounding my references to the use of flood water courses and discharge tunnels with the storage capacity of domestic reservoirs. What my paper purports to say is that it should be compulsory to make flood watercourses to protect large reservoirs, and that they should be constructed at the outset to be available during the construction of the embankment, to avoid having to make a large discharge tunnel to deal with a maximum flood not required on the completion of the works. The importance of making the storage capacity of the reservoirs sufficiently large to control the floods from a drainage area has been answered. In reference to the number of gallons stored per acre of drainage, this factor was arrived at from several years' stream gaugings in three Pennine valleys providing water for Oldham; and it will be observed in my table that this borough stands at the head of the list of "Gallons Stored per Acre of Drainage Area." With an average annual rainfall less than 48 inches, there are times when the whole series of sixteen reservoirs are full and overflowing, with an aggregate storage of more than 70,000 cubic feet per acre. With a higher average annual rainfall than 48 inches on the Pennine Hills, I should recommend more than 70,000 cubic feet storage per acre, but less (say) in the Midland Counties, where the rainfall is not so great. I would venture to remind Mr. Askwith that on sites of reservoirs where rock exists under the valley alluvium, it must be cut off in the central trench to make sure of securing a water-tight reservoir. Whatever be the nature of the ground forming the submerged area, an impervious trench must be secured, not only across the valley, but at both ends, by "wing trenches" or otherwise. Having made the central trench secure in the way suggested, any structural material, be it rock, clay, or earthwork, for the embankment, may be confidently removed from within the reservoir area. Regard, however, must be paid to the dip of the strata, and nothing left to chance, or what has succeeded, or failed, on any other works. Each work must be dealt with on its own stratigraphical lines, and not as per any rules where the genius of the engineer ends. A sound reservoir is worth all the jewels in the city or borough owning it. Valleys supporting the Pennine range are not so close together that we may expect a reservoir leaking from one depression into another a mile or more away. Friction alone has great power of resistance, and sand proves water-tight where there is sufficient of it placed in the barrier. Soil and semi-puddle should be reserved for backing on each side of the puddle wall—the better qualities being used on the inner side. A few small stones in clay improve it, as does a judicious mixture of sand improve rich clay; but a discriminating mind is required to know when and how to use them, as mistakes in practice are soon exposed. With reference to the cost per million gallons storage, for completed works, no definite conclusions can be drawn. Perhaps the best way of comparing the relative cost is to estimate the structural cost only, including material, aggregate quantities being compared. No two works are precisely alike physically, but there should be no difficulty in comparing structural works to find out merit, and put down pretention. Liverpool, Manchester, and Birmingham have the source of their works far afield, and cannot be estimated at the cost per million gallons storage for comparison, the conditions not being alike, though, to some extent, they are examples of impounding lakes. In reply to Mr. Matthews, the greater sum includes the lesser. The £210 includes labour and material only, while the £485 8s. 9d. includes all possible expenses covering the money borrowed. In preparing estimates of this kind, however, there are so many diverging factors that it is difficult to draw a fair comparison—the quality of the work being not the least important. Some corporations buy up all the farms on their drainage area, and sacrifice the rents to have pure water, and have long tunnels to drive also, which add to the primary cost. Replying to Mr. Clemesha Smith, I do not oppose the construction of concrete dams where the substrata are uniform in structure across the valley on which the superstructure is built, preferably on a rock foundation. We have no evidence that concrete is better or more enduring than earthen dams, judging from the ancient monuments of this class built in the East hundreds of years ago, and which exist to-day more firm even than on the day of completion. Where stone is plentiful on the site, and suitable clay scarce, a concrete barrier may be built to advantage, the physical conditions being favourable; but the fact must not be overlooked that, as a superstructure above the surface of the ground, an earthen embankment possesses all the qualities of an impervious barrier present in concrete, and at less cost. For trench material below the floor of the valley, concrete is far superior to puddle; and it is for this use I recommend it. I cannot imagine a case where it would be better to use puddle, as suggested by Mr. Smith—especially in wet substrata watered under high pressure and in rock. The other points raised by Mr. Smith have been answered in reply to other speakers; and I have nothing to withdraw in recommending ample storage room per acre of drainage, considering that large floods come a few times a year only, when, if they are not collected, unknown quantities of water are wasted. If corporation engineers would put down self-recording stream-gauges on their main streams, they would learn a lesson of the richness or poverty of their watershed not taught by the rain-gauge.

DETERIORATION OF COAL.

This subject was dealt with by Messrs. Parr and Wheeler in a paper in the "Journal of the American Chemical Society," of which an abstract appears in the current number of the "Journal of the Society of Chemical Industry."

The authors observed a kind of deterioration of coal which cannot be described as "weathering," but which rather appears to be due to the removal of the coal from the conditions under which it existed in the seam. Samples taken from the seam were packed without drying, in gas-tight jars; when these were opened ten months afterwards, a slight pressure of gas was observed, and the gas ignited with a strong blue flame. In another series the coal was air-dried, and placed in the jars so as to occupy only about one-fourth of their capacity. When the jars were opened after eighteen months, a considerable absorption of oxygen was found to have taken place; the atmosphere in the jars containing less than 1·5 per cent. of oxygen and 2 per cent. of carbon dioxide. Between the time of mining and the delivery of the coal at its destination, a drop in calorific value has been observed. Losses of 1·3 to 3·4 per cent. have been recorded as the result of ten months' storage in the laboratory. This loss apparently occurs during the first two to three weeks after mining, and is attributed to the liberation of combustible gases owing to the release of the conditions of pressure and sealing in the seam. The authors have made observations on the deterioration of coal by "weathering," which may be ascribed to the oxidation of certain of its constituents. Pillars of coal which had been exposed for 25 years in the mine showed a loss of 2·5 per cent. in calorific value as compared with freshly exposed coal in adjacent seams. The loss described as "weathering" takes place in a dry atmosphere just as much as on exposure to the weather; but the losses under this head do not appear to exceed 3 to 4 per cent. No loss occurs if the coal is submerged in water.

SOCIETY OF CHEMICAL INDUSTRY.

Annual Meeting in Newcastle-on-Tyne.

The Annual Meeting of the Society was formally opened in the Armstrong College, Newcastle-on-Tyne, last Wednesday—Sir Boverton Redwood in the chair. On the platform were the Lord Mayor (Mr. W. J. Sanderson), the President-Elect (Mr. Raphael Meldola, F.R.S.), the Hon. Treasurer (Mr. Thomas Tyrer), and the General Secretary (Mr. C. G. Cresswell).

The Lord Mayor, on behalf of the Corporation and citizens of Newcastle, and Professor Lebour, the Vice-Principal of the Armstrong College (in the absence of the Principal, Sir Isambard Owen), on behalf of the Council, offered the visitors a hearty welcome.

The President having briefly acknowledged these courtesies, the General Secretary announced the election of the Council for the current year, and the choice of Mr. Meldola as President. The Hon. Treasurer then presented a report showing a balance of about £93 of revenue over expenditure.

The General Secretary next read the report of the Council. It showed that the number of members on the register was 4517, compared with 4519 at the last annual meeting. During the year 267 members were elected, as compared with 321 last year; and the losses were 269, against 231. There were 47 deaths, compared with 42 last year. Among the deaths were Sir John Evans and Sir William H. Perkin, who had filled the office of President. During the past session, 96 original papers with discussions had appeared in the "Journal," compared with 111 for the previous session. The Society's medal had been awarded to Sir Andrew Noble, K.C.B., F.R.S., for conspicuous services to applied chemistry, in connection with explosives; and the Yorkshire Section had established a "Priestley" medal, to be awarded every third year to a member of the section for original research. The Hurter Lecture was delivered by Sir Oliver Lodge, D.Sc., F.R.S., who selected as his subject "The Structure of the Atom."

The reports of the Treasurer and Secretary having been adopted, the President presented the Society's medal to Sir Andrew Noble, who, he said, was well known to the members on account of his illustrious exposition of the principles which governed the combustion of explosives in the propulsion of projectiles. Sir Andrew, in responding, thanked the Society for the high honour they had conferred upon him, and said the medal should be kept as one of his most cherished possessions.

President's Address.

The President then delivered his address, which was devoted to a consideration of the question of the adequacy and duration of the world's supplies of petroleum, in relation to the use of liquid fuel in the belligerent marine service, and the rapidly extending use of the automobile road vehicle. He began by giving a brief historical account of the inception of the petroleum industry, and of the marvellous growth which had taken place within the past half-century. He claimed that petroleum products now played a part of immense importance in supplying many of the chief wants of the world, and mentioned that it had, in fact, been suggested that the degree of civilization of a country or nation might be measured by the average consumption of petroleum as a lighting fluid for each unit of population, though this, he considered, was only true up to a certain stage. In discussing the probable duration of our supplies, the question of the origin of petroleum could not be ignored. If there were reasons to believe that petroleum was the product of some inorganic chemical reaction at present in such progress as to lead to the rapid replenishment of the stores which were being depleted, we might obviously divest ourselves of anxiety as to the future; but unfortunately there seemed to be no adequate basis for such a belief. On the contrary, the available evidence pointed to the conclusion that petroleum had been produced from organic matter by very gradual changes which had occupied a vast amount of time; and it might be said that the creation of the stores of petroleum which now give us light and heat ceased about the time when life in its biped form first appeared on the earth. It was therefore evident that in respect of petroleum, as in regard to our coalfields and the Chile nitrate beds, we were living on our capital; and we were naturally led to consider how long that capital would last. When petroleum was only retailed by the pint for use in domestic lamps, or sold by the gallon for the lubrication of machinery, a moderate quantity went far. But when we began to burn it by the ton, as a substitute for coal, an entirely different set of conditions was introduced; and the effect of this most important change in the character of the industry had not yet become adequately realized. He had pointed out in 1903 that even if the whole of the world's output of petroleum were doubled, and the surplus thus created were used as fuel, this surplus would, taking into account the relative thermal efficiencies, only be equivalent to about 5 per cent. of the world's output of coal. He therefore adhered to the opinion he expressed at that time, that there would be certain selected applications of liquid fuel where the advantages of employing such a fuel were especially obvious, but that for anything like general employment, he could not see where we were to look for adequate supplies. Foremost among these selected applications was that of steam-raising in ships of war; and it was common knowledge that the British Admiralty were fully alive to the importance of this. In engineering circles there had been lately some discussion of the suggestion that even our largest battleships might be propelled through the agency of gas-engines and gas-producers. But the highest authorities evidently considered that there was no probability of so radical a change being effected in the near future; and it might safely be said that just as the incandescent mantle had enabled coal gas to withstand the competition of electricity as a source of light, and had given it a new lease of life as an illuminating agent, so the substitution of the Parsons turbine in place of the reciprocating steam-engine, coupled with the use of liquid fuel, would delay for a long time the introduction of the internal-combustion engine as a source of power in the larger ships. The world's production of crude petroleum for 1907 was approximately 8988 million gallons. This quantity would fill 3,456,948 10-ton railway tank-waggons, and these would make a train 13,749 miles in length. A study of the statistics relating to the output of crude petroleum made it clear that the world was mainly dependent for its supplies upon the United States and Russia, and that no countries under the British flag, other than Canada, Burma, and Assam, contributed to the supplies. In view of the importance of oil fuel to the British Navy, it appeared to be a national duty to develop as far as possible the petroleum resources of the Empire, in order to place this country in a more favourable position in respect of the control of supplies. It was, however, chiefly in regard to supplies of petroleum spirit suitable for use in automobile vehicles that anxiety prevailed. The consumption of motor spirit in Great Britain was growing very fast; the imports having increased from 474,610 barrel-units of 41 Imperial gallons in 1905 to 809,280 barrel-units for 1907. The automobile industry, in which no less than 12 millions sterling had already been invested in this country, was dependent for its existence upon a supply of a suitable combustible liquid; and it would thus be seen that the question of the maintenance of the supply was of great industrial importance. It was most difficult to forecast the future in such a case. These remarks naturally led to the consideration of the question of substitutes for petrol; and foremost among those to which public attention had recently been directed was the coal-tar product benzol, which could be obtained in considerable quantity if the patent coke-ovens in this country were provided with means for its recovery from the waste gases. Shale spirit might also be more largely produced. Lastly, we had in alcohol a source of power which might be made available under suitable conditions; for alcohol could be readily and rapidly produced in almost unlimited quantities. In conclusion, it might be said that though the vast and highly important industry dealt with in the address exhibited many features of which its creators might justly be proud, there would be ample scope for the exercise in it of the abilities of highly-trained specialists for many years to come. Among other problems to which the industrial chemist might be advised to direct his attention were those of the conversion, by dissociation, of some of the hydrocarbons into others of higher volatility, the improvement of the exisiting methods of fractional distillation, the more effective separation of the solid hydrocarbons from the liquid, the substitution of a more rational process for that part of the operation of refining which consisted in the barbaric treatment of the distillate with sulphuric acid, and the devising of some better method of eliminating sulphuretted compounds from petroleum containing these objectionable impurities.

A cordial vote of thanks having been passed to the President for his address, it was decided to hold the next annual meeting in London, at the same time as the International Congress of Applied Chemistry, particulars of which have already been given in the "Journal."

Thanks were accorded to the President and Council of the Armstrong College for the use of the building, and the proceedings closed.

The company were subsequently entertained at luncheon, in the Grand Assembly Rooms, by the local Reception Committee. Dr. Russell Moore proposed "The Newcastle Section of the Society of Chemical Industry;" and it was acknowledged by Mr. N. H. Martin, the Chairman of the Section, who is President of the Pharmacy Section of the International Congress of Applied Chemistry.

The afternoon was devoted to a river excursion on the Tyne, on the invitation of the Lord Mayor of Newcastle. The party were landed at Messrs. Palmer's Shipbuilding Yards; the firm throwing open their works to inspection. An example of their capacity for naval construction was shown in the first-class battleship *Lord Nelson*, which was just nearing completion. A reception and *conversazione* in Armstrong College concluded the proceedings.

Thursday was given up to visits to works; but only those connected with the carbonization of coal will be of special interest to our readers.

A Visit to the Newcastle Gas-Works.

The Directors of the Newcastle-upon-Tyne and Gateshead Gas Company had invited members to inspect their Redheugh works. Those who accepted the invitation were met at the Haymarket by Mr. W. Doig Gibb, the Company's Engineer, and were conveyed in breaks across Redheugh Bridge, remarkable for the fact that it was constructed mainly with the help of the Newcastle Gas and Water Companies, for the purpose of carrying their pipes from the Gateshead side of the Tyne into Newcastle. The party were

conducted through the works by Mr. Gibb and his Assistant Mr. T. Hardie (the Manager of the station); Mr. Alfred Allhusen, one of the Directors also being present to receive the guests.

A concise account of the origin and progress of the Company was distributed to the visitors; and from it the following particulars are taken: Gas-works were first established in Newcastle in 1817, by the proprietors of the Newcastle Fire Office, with stations at the Manors and in Forth Street. On Jan. 10, 1818, the first lighting by gas was carried out in Mosley Street. In November, 1828, the Newcastle Subscription Gas Company was formed; and exactly two years later they purchased the undertaking of the old Company. Gas-works were erected in Sandgate in 1831. In 1838 the Company purchased the pipes and lamps belonging to Mr. Richard Grainger in the new streets laid out by him. In the same year, a Company was formed which took over some small gas-works in Gateshead; and the two Companies then amalgamated. In 1859 the Elswick Gas-Works were opened, and those at the Manors and Sandgate closed. In the same year the Company was incorporated under the Joint-Stock Companies Act, and in 1864 was registered by Special Act. Next year the Blaydon Gas-Works were purchased from Mr. Joseph Cowen; and two years later further parliamentary powers were obtained. In 1873 the stocks were consolidated and the auction clauses introduced; the sliding-scale being adopted in 1879. The Redheugh works were inaugurated on Oct. 24, 1876; and the Grainger Street offices opened on Feb. 1, 1884. By their Special Act of 1896, the Company obtained powers to construct gas-works at St. Anthony's. In the manufacturing department, the progress made may be epitomized as follows: 1899.—West's stoking machinery in No. 4 retort-house, and exhauster house and machinery for forcing gas to Newcastle. 1900.—No. 4 station meter, three tower scrubbers, six purifiers, and West's stoking machinery in No. 3 retort-house. 1901.—Coke conveyors and a check purifier. 1902.—Oil-gas plant, and West's stoking machinery in No. 2 retort-house. 1903.—New boiler, stoking machinery, new purifier, and oil-gas plant. 1904.—Tidal dock, acid storage-tanks, 40-ton weighbridge, and anti-freezing apparatus for four gasholders. 1905.—Exhauster (130,000 cubic feet), Livesey washer, two boilers, and oil-gas plant. 1906.—De Brouwer machinery and overhead coal-hoppers in No. 1 retort-house, 10-ton cart-weighing machine, Livesey washer, and outside producers.

As a description of the Redheugh works was published in the "JOURNAL" for July 18, and Oct. 10, 1899, it may suffice to refer to some of the additions since made. Interest was shown in the working of the outside producers and the De Brouwer machinery in No. 1 retort-house. The other retort-houses (three in number) are fitted with West's stoking machinery. Each of the houses forms a complete unit, with its condensing, scrubbing, and purifying plant; but all parts of these are interchangeable between the different houses. The sulphate plant was also inspected; and the arrangement for de-arsenicating the sulphuric acid by means of the waste gases from the stills before passing the latter to the Claus kiln, aroused much interest. A new gasholder in course of construction will, on completion, be the largest spiral holder in this country.

At the close of the inspection, the party were invited to luncheon by the Directors of the Company. The Chairman (Sir William Stephenson) having given the usual loyal toast, which was duly honoured, Mr. Allhusen welcomed the guests; and Dr. R. Lessing replied on their behalf—thanking the Directors for their hearty reception, and congratulating them on the efficient state of their works.

In the afternoon, a party went to Messrs. Priestmann's Otto-Vale Coke-Oven Works, where they saw a modern plant of the Otto-Hilgenstock type, which carbonizes 450 tons of coal daily in two sets of 40 ovens each. The recovery of tar, ammonia, and benzol is carried out according to the latest methods; the benzol-rectifying plant having only been set to work quite recently. The waste heat of the flue gases and the surplus gas are utilized under five Babcock and Wilcox boilers, raising steam for two Parsons turbo-generators of 2000-kilowatt capacity. As a little higher up in the valley a range of 112 beehive ovens is still in operation, the old and new methods of making metallurgical coke from the same coal offered a rare opportunity for detail comparison.

Another party went to the works of Messrs. Bell Bros. at Middlesbrough, where a battery of Hüssener ovens is worked, and bye-products are recovered in a similar manner.

The Union des Gaz Company's Labourers.

With reference to the paragraph in last week's "JOURNAL" on the threatened strike of the labourers at the Italian gas-works of the Union des Gaz Company, we now learn from a Milan newspaper of the 18th inst., that the London Board of Directors have acceded to the men's demands. From Sunday, the 19th inst., the yard men resumed their usual Sunday hours of labour—namely, up to two o'clock in the afternoon, an arrangement which will apply also to holidays. Thus is removed one of the chief causes of discontent recently rife among the labourers employed by the Company.

Mr. John Gamon, the Chairman of the Chester United Gas Company, whose death was recorded in the "JOURNAL" for the 9th ult., left £22,999.

TESTS ON VERTICAL RETORTS AT DESSAU AND OBERSPREE (BERLIN).

By M. FREYSS.

[Abstract of a Paper read before the Société Technique du Gaz.]

M. Freyss and M. Cesari were entrusted by the Union des Gaz Company during last year to test and report upon vertical retorts. Tests were therefore made by them, in company with MM. Foiret and Roy, at the Oberspree (Berlin) and Dessau works.

The various advantages claimed by the Bueb system of vertical retorts are well known, and may be summarized as follows: (1) Large make of gas per unit of surface; (2) high yield in gas per ton of coal carbonized; (3) large make per retort and per 24 hours; (4) almost entire absence of naphthalene; (5) reduction by half in the amount of sulphur in the gas; (6) production of 50 per cent. more ammonia than by horizontal or inclined retorts; (7) liquid tar rich in oils; (8) fewer stoppages in ascension-pipes; (9) larger and harder coke; (10) slight formation of graphite in retorts; (11) considerable saving in retort-house labour.

Some of these advantages are derived directly from the introduction of steam during the last two hours of carbonization, with the object of making a certain amount of water gas, varying according to requirements up to 15 and 18 per cent. of the total make. This addition of water gas gives great pliability to the make, without necessitating special water-gas plant. As will be seen, the lighting power of the gas thus obtained does not conform to normal requirements—that is, to 105 litres per carcel—unless it is specially carburetted. In Germany, the question of the illuminating power plays a less and less important part. In several towns the gas is considered adequate when its heating power reaches 5000 calories per cubic metre at 15° C. and 760 mm. barometric pressure.

At the Oberspree works, this result is obtained in practice with a make of 365 cubic metres of gas to the metric ton (13,097 cubic feet per ton), which was the average for the month of July, 1907. The lighting power under these conditions is 12 Hefner candles, corresponding to about 190 litres per carcel. In other towns, they are more particular about the standard of lighting power; but, generally, German municipalities are content with a much lower standard than is usual in France. In these circumstances, the question of the lighting power obtained from the vertical retorts was of great importance, and was the principal object of our investigation. Before giving the details of our tests, we will give a general description of the retorts and their working.

RETORT-BEDS.

The retort-beds at Dessau and at Oberspree are of the same type. At Dessau: 10 retorts per bed, 4 metres (13 ft. 1½ in.) long, of rectangular section, 700 mm. by 360 mm. (27½ in. by 14¼ in.) at the bottom, and 560 mm. by 200 mm. (22 in. by 8 in.) at the top. At Oberspree: 12 retorts per bed, 5 metres (16 ft. 5 in.) long, 700 mm. by 360 mm. at the bottom, and 470 mm. by 200 mm. (18½ in. by 8 in.) at the top. By working special dampers, the heating of a certain number of the retorts per bed can be cut off.

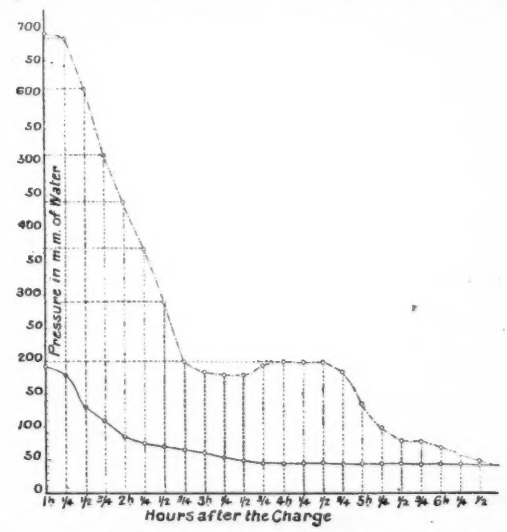

Fig. 1.—Pressures in Five-Metre Retorts at Oberspree—Showing the Comparative Effect of Small and Separated Coal.

The charges per retort vary at Dessau from 490 to 515 kilos. (1080 to 1135 lbs.); and at Oberspree from 540 to 580 kilos. (1190 to 1279 lbs.). The time of carbonization varies from 9 to 12 hours according to the nature of the coal. The retorts are filled to within about 500 mm. (20 inches) of the top.

Temperature of Retorts.—Measured by Féry and Wanner pyrometers, the average temperature inside the retorts at Oberspree was: At the bottom, 1040° C.; below the middle, 1020° C.; above

the middle, 950° C.; at the top, 830° C. In the flame passages, the temperatures were—

	At Oberspree. Deg. C.		At Dessau. Deg. C.		
At the bottom section at the nostrils . .	1400	..	1260	1300	1290
At the second section.	1340	..	1210	1220	1230
At the third section	1050	..	1010	1020	1240

The temperatures gradually decrease towards the top of the retort. Generally, there was little difference in the temperature of one retort or another.

Retort Pressures.—The high pressure at Oberspree in the retorts charged with unscreened coal has rendered necessary the adoption of a very ingenious system for the separation of the coal. Before falling into the coal reservoirs, it passes through a screen, and is sorted into dust and into larger pieces. The reservoirs and the retort-charging hopper are separated by a longitudinal division plate, so that the coal is classified according to its size. At the time of charging, the coal falls in two streams, and forms in the

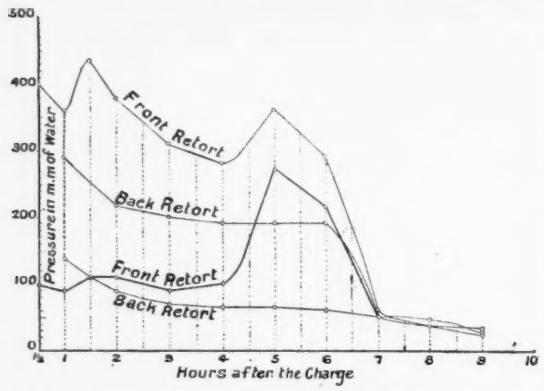

Fig. 2.—Pressures in Four-Metre Retorts at Dessau, where the Coal is not Separated.

retort two vertical layers of coal of different sizes. The gas can get away through the spaces left by the larger pieces, and this considerably reduces the pressure in the retort. Fig. 1 shows the difference at Oberspree between the pressures of two retorts—one charged with small unscreened coal, and the other with separated coal. Fig. 2 shows the pressures in several retorts at Dessau, where the separation of the coal is not done.

Producers.—The furnaces are clinkered every 48 hours, both at Oberspree and at Dessau. The clinkering is easily done, owing to the construction of the producer.

Fuel Used.—At Oberspree we found a consumption of 157 kilos. of Boldon coke (moisture not deducted) per ton of coal carbonized without the admission of steam. Deduction was made for the good coke taken out of the ash-pans. MM. Foiret and Roy found at Dessau a consumption of 159 kilos. of Lens coke per ton of coal carbonized. According to Mr. Körting, the consumption of fuel for a bench at Mariendorf is 140 kilos. as an average. The admission of steam into the retorts at the end of the carbonization has the effect of raising the proportion of fuel. At Cologne, with 4-metre retorts, the following results have been arrived at: Carbonization without steam, 156 kilos. of coke per ton; carbonization with steam, 173 kilos. of coke per ton. However, if the fuel percentage were expressed in relation to 100 cubic metres of gas made, it would be less in the second case than in the first. These figures seem to show that the fuel used for a bed of retorts 5 metres long is less than that for one with retorts 4 metres long.

Working the Retorts.

Working vertical retorts is much less laborious than either horizontal or inclined retorts. The discharge of the retort is done by simply moving a lever. Throughout our tests, the drawing was done perfectly. It is quite certain that the use of steam greatly facilitates the withdrawal of the coke, because it all but abolishes the formation of graphite. But it should be added that during our tests there was no admission of steam; and at Dessau they had long worked without steam, and no trouble in drawing had been experienced. The retorts, of course, must be scurfed in good time. The coke coming from the retorts falls direct into a De Brouwer conveyor. At Oberspree this conveyor is placed in front of the bench; while at Dessau and Cologne it is immediately below the retorts. The arrangement at Oberspree seems preferable. The charging of the retorts is as simple as for inclined retorts. In order to protect the lower lids, 25 to 30 kilos. (55 to 66 lbs.) of coke dust are put into the retort before the charge. This is easily done. The stoker's work can be done by any labourer. On the other hand, vertical retorts require continual attention on the part of the foreman, who three or four times every 24 hours has to take the temperatures at the nostrils, and to watch the draught, which is easily done by gauges on the flues. Neither at Oberspree nor at Dessau did we notice obstructions in the ascension-pipes or hydraulic mains. The former should, however, be systematically cleaned. To avoid the formation of heavy tar in case of too high a temperature of the retorts, the hydraulic mains are provided with movable false bottoms on which the thick tar can be deposited. These are periodically cleaned.

Retort Labour.

As at Dessau and at Oberspree only two beds were in fire during our tests, the labour could not be reduced to less than one man per eight-hour shift, to which was added an extra man at night—that is, four men per 24 hours. According to Mr. Körting, the same staff of four men working in two squads can work a bench of seven beds of 12 retorts, 5 metres long, at Mariendorf. One man carbonizes 24 tons, and produces 8700 cubic metres (307,250 cubic feet) of gas per 24 hours. The service of the conveyors and of the clinkering is not included in this figure. At Cologne, 120 retorts 4 metres in length are worked by 11 men, including looking after the conveyors and producers, in 24 hours. One man carbonizes 13 tons and produces 4300 cubic metres (151,860 cubic feet) of gas in 24 hours. Vertical retorts, therefore, effect a considerable saving in labour over that required for machine-worked horizontal or inclined retorts.

Results of Tests.

Both at Oberspree and at Dessau we experienced difficulties in determining the average lighting power of the gas while making photometric tests on the gas in the holders. On the one hand, it was not always possible to store all the make for one test in the gasholders; on the other hand, the necessities of the works prevented isolating one gasholder for a sufficient time to allow the gas to form a homogeneous mixture. The most practical method was to have photometric tests of the gas made every half-hour during a complete cycle of manufacture. Then, the total of the partial illuminating powers multiplied by the hourly production of gas, and divided by the total make, would represent the lighting power.

So also the calorific power was ascertained. We could not use the standard Dumas and Regnault photometer, as it is not suitable for measuring the lighting power of very bad gas at the end of the carbonization. We got over this difficulty by comparing, on a Bunsen photometer, the standard Bengel burner of the Dumas apparatus with the Hefner standard. The photometer thus improvised was frequently compared with the Dumas and Regnault instrument, and the results of the two agreed exactly. The calorific power was ascertained by a Junkers calorimeter. The volumes of gas were all reduced to 15° C. and 760 mm. pressure. It is interesting to note, generally, that there is a sufficiently perfect agreement in the variations of lighting and heating power expressed as percentages of the whole. Towards the end of the period of carbonization, however, the lighting power falls off more quickly than the heating power. This agreement does not, of course, hold good when steam is used at the end of the carbonization.

We began our tests at Oberspree on July 29, 1907; carbonizing Boldon coal without steam, the temperature of the settings above the nostrils being 1400° C. The average lighting power being 128 litres to the carcel, we reduced the temperature to 1350° C. in the hope of getting a better gas. The less complete carbonization had no effect on the lighting power. We reduced the temperature further to 1300° C.; but this was altogether insufficient for the 5-metre retorts. The upper part of them was much cooled and the coal badly carbonized. On the other hand, at this moment leakages showed themselves at the lower part of the retorts, and were not completely remedied during our tests. Without this the yield of gas would certainly have been higher. It is possible that the cooling of the settings may have been partly the cause of these leakages; but probably they came from the asbestos joint of the bottom mouthpieces. At Dessau the joints were made with iron filings and held very well. These tests showed that it was idle to reduce the temperature of the 5-metre retorts with a view to obtain better quality of gas. The tests were therefore continued at a temperature of 1400° C.

As after the tests at low temperature the works were short of gas, on the 3rd and 4th of August steam was introduced into the lower part of the retorts during the last 2½ hours of carbonization. The make of gas during these two days was 379 and 380 cubic metres (about 13,635 cubic feet) per metric ton of coal carbonized. The lighting power fell to 171 litres per carcel. It is remarkable that the heating power under these conditions was still 4970 calories. Without other change, but merely by suspending the admission of steam, the make of gas fell again to 308 cubic metres (11,052 cubic feet per ton), with a lighting power of 123 litres to the carcel and 5495 calories. The increase of make during the working with steam was 18·7 per cent. of the gas mixture. It is easy to check by a calculation that this increase is only due to the manufacture of water gas. Being given that the calorific power of the water gas is 2700 calories per cubic metre, that the calorific power of the gas obtained by injecting steam is 5495 calories, and that of the mixture 4970 calories, the proportion of water gas contained in the mixture is shown by the equation—

$$2700\,x + (1 - x)\,5495 = 4970,$$

where $x = 0{\cdot}186$, or 18·6 per cent. of water gas in the gas mixture.

The results of tests with Lambton coal were very little different from those with Boldon coal. Having been unable to get a gas of regular standard power with the 5-metre retorts at Oberspree, it was of interest to recommence these tests with the same coal (Boldon) in the 4-metre retorts at Dessau. The Imperial Continental Gas Association kindly supplied us with 50 tons of the

same Boldon coal. The average composition of the coals carbonized at Oberspree was the following:—

	Boldon Coal. Per Cent.	Lambton Coal. Per Cent.
Moisture	2·2	2·1
Ash	7·1	9·4
Fixed carbon	59·8	58·7
Volatile matter	30·9	29·8

The Boldon coal carbonized at Dessau was the same in composition as that used at Oberspree. In the 4-metre retorts at Dessau it gave results that were not expected after those at Oberspree. During three days' test, the average lighting power of the gas was 103·4 litres to the carcel, the heating power 5520 calories per cubic metre, and the average make 321 cubic metres per metric ton at 15° C. and 760 mm. (or 11,518 cubic feet per ton). Boldon coal carbonized in the horizontal retorts gave an average of 305 cubic metres (10,944 cubic feet) per ton at a standard lighting power of 104 litres to the carcel. The results obtained at Dessau seem, therefore, to prove that vertical retorts of 4 metres produce a gas of at least equal lighting power to that from horizontal or inclined retorts. The contrary would, moreover, be surprising, for the gas made in the vertical retort gets away very rapidly, and leaves it at a low temperature. The retort being stuffed full, the illuminating hydrocarbons are less likely to be decomposed by lengthened contact with the overheated sides of the retort. The small proportion of pitch produced, and the reduction of naphthalene in the gas, seem to prove this. The great difference in the lighting power of the gas made from the same quality of coal in a 4-metre retort and that produced in a 5-metre retort, is explained by the higher temperature of the latter and the less rapid getting away of the gas produced. The following is the comparison of the composition of the gas obtained, without the introduction of steam, from the same quality of Boldon coal:—

	Oberspree.	Dessau.
Duration of carbonization	12 hours	10 hours.
Carbonic acid	1·2 per cent.	1·6 per cent.
Hydrocarbons	3·9 ,,	3·6 ,,
Oxygen	0·0 ,,	0·0 ,,
Carbonic oxide	3·5 ,,	5·2 ,,
Hydrogen	58·5 ,,	52·4 ,,
Methane	31·4 ,,	33·4 ,,
Nitrogen	1·5 ,,	3·8 ,,
Lighting power per carcel	116 litres	103 litres
Calorific power	5460 calories	5490 calories.

The small proportion of carbonic oxide is surprising. On the other hand, the larger proportion of hydrogen in the gas at Oberspree and the smaller proportion of methane are explained by the longer duration of the carbonization. It is rather curious that the gas at Oberspree, the lighting power of which is much less than that at Dessau, should be richer in hydrocarbons. However, to draw a conclusion of the lighting power from the composition of the gas would require a series of analyses and the determination of the proportions of ethylene and benzol. This could not be done, owing to want of time; but it is probable that the gas at Dessau was richer in benzol than that at Oberspree. It is interesting to note that in the 4-metre retorts at Dessau, we carbonized an average of 1176 kilos. of coal per retort in 24 hours; while at Oberspree, in the 5-metre retorts, this average was only 1110 kilos. The 4-metre retort is, on this showing, also the more advantageous, even when carbonizing without steam.

At Berlin, where the lighting power of the gas is of secondary importance, it is possible to push the carbonization to the extreme, and to make an exceptionally high proportion of water gas, which necessitates a lengthened injection of steam, and increases the time of carbonization. This large amount of steam will not be entirely decomposed at a temperature below 1400° C. On the other hand, it is considered at Berlin that carbonization in twelve hours has the advantage of simplifying the spread of the charges and of reducing the number of shifts to two, regularly alternating day and night. It is thus that the choice of the 5-metre retort is explained. However, when it is only required to make a small amount of water gas, or none, the 4-metre retort has an undoubted advantage over that of 5 metres, with the view of getting a gas of higher illuminating power, as is required by the majority of the municipalities of France.

Bye-Products.

The coke obtained at Dessau and Oberspree was of very good quality, hard, and of metallurgic appearance. This may be an advantage in certain cases and a disadvantage in others. According to our information, the coke sells very well in the two towns, and for domestic purposes a higher price is obtained for it than for ordinary gas coke. The tar produced was particularly liquid, and its browny colour showed that it contained more lighter oils than ordinary tar. The proportion of ammonia and of naphthalene in the gas made was not specially inquired into through shortness of time.

In the following table is given a general summary of the tests made at Oberspree and Dessau:—

Date, 1907.	Place.	No. of Retorts in Fire.	Length of Retorts.	Duration of Carbonization.	Nature of Coal Carbonized.	Temperature at the Nostrils.	Coal Carbonized per Charge and Retort.	Coal Carbonized per Retort and 24 Hours.	Gas Made per (Metric) Ton per 24 Hours.	Gas Made per Retort and 24 Hours.	Lighting Power, Litres per Carcel.	Calorific Power.
			Metres.	Hours.		Deg. C.	Kilos.	Kilos.	Cub. Metres.	Cub. Metres.	Litres.	Calories.
July 30	Oberspree	18	5	12	Dry Boldon without steam	1400	568	1136	313	356	128·2	5411
,, 31	,,	18	5	12	Wet Boldon without steam	1350	560	1120	322	360	129·0	5471
August 3	,,	22	5	12	Dry Boldon with steam	1400	545	1090	379	413	171·0	4970
,, 5	,,	22	5	12	Dry Boldon without steam	1388	540	1080	308	333	123·0	5495
,, 6	,,	22	5	12	1/4 Boldon, 3/4 Lambton	1400	563	1126	304	342	118·0	5470
,, 7	,,	22	5	12	Lambton without steam	1400	551	1102	310	342	129·0	5260
,, 11	Dessau	20	4	10	Boldon without steam	1300	490	1176			105·0	5260
,, 12	,,	20	4	10	,, ,, ,,	1290	490	1176	321	377	103·0	5490
,, 13	,,	20	4	10	,, ,, ,,	1300	490	1176			102·0	5550

FINANCIAL DIFFICULTIES OF A SMALL MUNICIPAL GAS-WORKS.

By Robert W. Cowie, of Lockerbie.

[A Paper read before the North British Association.]

As a rule, papers at our meetings give accounts of some particular apparatus, plant, or experience of rapid developments in particular works or the industry as a whole; but I would to-day direct your thoughts to something a little different. It is my purpose in this paper to take you back a period of seventeen years, and show the financial difficulties which have hampered the development of the Lockerbie gas undertaking, and how they have been overcome.

In making comparisons between one works and another, there is more to be taken into account than merely the annual make of gas; the amount of capital of the undertaking, the distance from the coalfields and business centres, the nature of the district (whether rising or stationary), the rate of wages, and other conditions, all affect favourably or adversely the progress of the undertaking. But, of them all, the first stated is one of the most important factors. Many local authorities look with covetous eyes at gas companies, especially at the end of each financial year, and think that the 7½ or 10 per cent. would be better in the pockets of the ratepayers. Lockerbie was one of these; and probably, in course of time, nearly all local authorities will own gas undertakings.

In these modern days we hear of electric light undertakings receiving grants from the profits of gas-works under the same management, and receiving large sums for public lighting in preference to gas—not because the light is better, but rather to help the tottering finances of the undertaking.

In Lockerbie, I am sorry to say, the gas-works have had to be financially assisted by grants, varying from 1d. to 5d. per pound, from the burgh assessments, which rate is known as the gas contingent guarantee rate. Happily the works are now in a position to pay their way; and it is the earnest hope and desire of the writer that the Town Council may soon decide to levy that rate no more.

For thirty-seven years the small town of Lockerbie had been supplied with gas by a Company; but the Town Council or Commissioners, thinking that they could conduct the works at a greater profit to the consumers and the town in general, decided to purchase the works. The burgh adopted the Burgh (Scotland) Gas Supply Act in 1891; and the Company were obliged to sell out. Valuators were engaged, and the price was fixed by arbitration at £4800, *plus* £382 10s. 8d. for tools, stock, &c.—a total price of £5182 10s. 8d. The annual make of gas then was 2 million cubic feet, and the price was 6s. 8d. per 1000 cubic feet. I will leave my hearers to judge whether the price was high or not. Certainly it proved to be high enough to seriously hamper the development of the undertaking for seventeen years, considering that provision had to be made for repayment of capital, interest on mortgages, interest on bank overdraft to carry on the works, and a sufficient sum in the discretion of the Government Auditor for reserve and depreciation.

At the end of the first financial year there was only £96 19s. 4d. as profit to meet £152 18s., being interest on loans and mortgages. Under ordinary circumstances, this would be paid out of revenue; but since this was not sufficient, the Commissioners

took advantage of the 38th section of the Burgh (Scotland) Gas Supply Act, which states,

"It shall be lawful for the Commissioners, and they are hereby required, from time to time to fix, impose, and levy such a rate, to be termed the gas contingent guarantee rate, as may be required to pay any annuities and any interest due thereon, and the interest of money borrowed under the provisions for the purposes of this Act."

The rate of 1d. was accordingly fixed. To raise the price of gas by 1s. per 1000 cubic feet would have gradually put matters right—provided, of course, that the consumption kept up. This, however, would be unlikely, considering the already high price of gas. The rate of 1d. brought £36 10s. 2d.; and the balance was carried as a net loss of £48 8s. 6d. to the next account.

The end of the next financial year brought no relief, but rather caused the trouble to increase. A rate of 2d. was imposed; and a net loss of £100 10s. 10d. was carried to the next account. In neither of these two years was there any sinking fund for the redemption of mortgages. The year following (1894) an engineer was called in to help the Commissioners out of their difficulties. According to his advice, the retort-bench was rebuilt; second-hand and larger purifiers, condensers, and a scrubber were got; and to meet this expenditure £600 was borrowed.

This requiring to be done three years after the purchase of the concern gives one some idea of the condition of the works at the time of purchase. At this time the Commissioners were considering ways and means of increasing the consumption of gas, in order to meet, as far as possible, their liabilities, and were of opinion that, if a small reduction could be made in the price of gas, it would be an inducement to many householders who were not consumers to start and use gas. More than half the householders at this time did not take gas, and it would also encourage present consumers to use it more freely.

The Commissioners then received a promise from a considerable number of householders that they would introduce gas to their houses if the price could be reduced a little, and if prepayment meters could be given them. This was the first of the prepayment meters in Lockerbie. They adopted this course, and reduced the price by 5d. per 1000 cubic feet, or from 6s. 8d. to 6s. 3d.; and in order to meet the increased estimated deficit for the year—not only caused by the reduced price, but because of the first instalment of sinking fund, which would be £135—they increased the contingent rate from 2d. to 5d. per pound.

At this time a few gentlemen in the town challenged in the Court of Session the legality of the action of the Commissioners, holding that it was their duty to fix the price of gas at such a price as would meet the necessary expenditure, in accordance with section 41 of the Burgh (Scotland) Gas Supply Act. The said section states:

The Commissioners shall from time to time fix the price to be paid for gas supplied during any succeeding year or half year. Until such price be altered by the Commissioners, the price so fixed shall remain in force; provided that the price shall be such as will as nearly as can be estimated raise sufficient income to discharge all the costs and expenses of and incident to the manufacture and distribution of gas made, together with the interest on all money borrowed in respect of the works, and to provide sinking fund, depreciation, and renewal fund to maintain the works in all perpetuity, and for all charges incident to the occupation of such works, and the moneys received in respect of and incident to the manufacture and distribution of gas shall be applied to such purposes only, and any balance at the termination of any year shall be carried to the debit or credit of the succeeding year.

The Lord Ordinary (Lord Low) held that the 38th section was designed for the security of annuitants, and only if the price of gas fixed in terms of the 41st section fails to bring in sufficient income, then, and not till then, could the Commissioners levy the gas contingent rate. In concluding, he said: "I am, therefore, of opinion that the defenders, in designedly fixing the price of gas from year to year at an amount lower than that which they estimated would be required to provide an income sufficient to meet all charges specified in section 41, act illegally, and that pursuers are entitled to decree in terms of the leading declaratory conclusions of the summons."

After this adverse decision by the Lord Ordinary, the Commissioners had a special meeting to consider the position of matters—whether they would accept the decision of the Lord Ordinary as final or appeal to the Inner Division of the Court of Session. After full discussion and consideration, they agreed to appeal. They accordingly did so, with the result that they won their case; the decision of the Lord Ordinary being reversed. On this occasion the Lord President held that the Commissioners were bound, before imposing a guarantee rate, to exhaust the yielding power of their price clause, and make the most possible out of the concern before resorting to a rate. "While the Statute is very imperative," he said, "there is underlying it an element of conjecture or estimate, because, read in a condensed form, the first duty of the Commissioners was to make up their minds what price would yield the largest sum. If every man who paid a sixpence would continue to pay one shilling, it would be a very simple process. But the contrary was notoriously the case; and the duty lay with the Commissioners to estimate and fix the price which would bring in the largest return." It being admitted that the Commissioners had done this, the case fell to the ground. He therefore recalled the Lord Ordinary's interlocutor, and dismissed the action.

After the turmoil of two legal actions, the Commissioners settled down to a policy of advancement, coupled with strict economy, and to gradually put the works in a thoroughly good condition. They decided to reduce the price of gas gradually, and, at the same time, reduce the contingent rate. The following table shows the gradual advancement made under this policy:—

Year ending May 15.	Price of Gas.	Contingent Rate.	Gas Sold. Cubic Feet.	Loans Outstanding at End of Year.	Capital per Million Cubic Feet of Gas Sold.
1892	6/8	1d.	2,277,000	£5400	£2371
1893	6/8	2d.	2,254,000	5400	2395
1894	6/3	5d.	2,220,000	5265	2371
1895	6/3	5d.	2,649,000	5730	2163
1896	6/3	5d.	3,168,000	5575	1759
1897	5/10	4d.	3,490,000	5420	1553
1898	5/5	3d.	3,775,000	5265	1394
1899	5/-	3d.	4,163,000	5110	1227
1900	5/-	3d.	4,421,000	4955	1120
1901	5/-	3d.	4,968,000	4800	966
1902	5/-	3d.	5,423,000	6145	1133
1903	5/-	3d.	5,505,000	5930	1077
1904	5/-	3d.	6,110,000	5715	935
1905	5/-	2d.	6,281,000	5500	875
1906	5/-	2d.	6,106,000	5285	865
1907	5/-	2d.	6,392,000	6570	1027
1908	5/- and 4/2	2d.	6,606,000	6295	952

From 1894 till 1901 nothing of particular note took place, except in 1897, when an exhauster and gas-engine were put in and paid for out of revenue, and in 1899 a house for the manager was erected—the reserve fund being drawn upon to the extent of £244, and the remainder put to capital account.

Up till 1901 the storage capacity in the works was only 14,000 cubic feet; and in that year a gasholder of 26,000 cubic feet capacity was erected. A new governor and station meter were also put in. At the same time, 1680 yards of main pipes were laid, 400 yards of which was extension, the remainder being larger pipes in place of smaller ones. This added £1525 to the capital account.

Three years later it was very apparent that more alterations would require to be done. The retort-house was in such a ruinous condition that the Town Council, as a Dean of Guild Court, could scarcely allow it to stand without something being done. The retort-bench was sadly in need of considerable repair, and gave very poor results. No more than 7900 cubic feet of gas could be got from coal which should have given nearly 10,000 cubic feet; and during the darkest of the winter months it was with difficulty, and at considerable risk, that the supply was kept up. The old question of ways and means was first considered. The reserve fund now amounted to £431; and, with £1500 borrowed at 3½ per cent. on the security of the burgh assessments, it was decided to make the works so complete that no more alterations would be required for a very long time.

A new retort-house and coal-store (64 feet by 34 feet inside) was built of red sandstone from the well-known Corncockle Quarries, which are quite near Lockerbie. The windows and doors are all arched, and the front side of the house is panelled and built in rock-faced rubble, giving the building rather a superior look. The coal-store is capable of storing 250 tons of coal, or ten weeks' supply. The retort-bench is built entirely free from all walls, and consists of three beds of retorts. Six retorts are set in one bed, and four in the other two beds. Each oven or bed is capable of receiving six retorts should it ever be necessary to put them in. The settings are Waddell's patent shallow regenerative, and give every satisfaction.

Instead of the usual plate flooring in front of the bench, we have Scott's patent travelling platform. The utility of this arrangement for small works is very marked, and all the advantages claimed for it are real ones. The hydraulic main is divided into sections, one for each bed of retorts, and each section has a gas and tar offtake. There is also a small pipe running along the hydraulic main, by which each section can be supplied with clean water or ammoniacal liquor. This is most convenient, especially during the winter months, when the hydraulic main can be flushed out once each week and a continual stream of liquor may flow through it.

A new vertical steam-boiler, from Cochrane and Co., of Annan, is placed in the retort-house. This is used only for steaming the producers and driving a Tangye pump when sending away tar and liquor.

New steel annular condensers, capable of dealing with 80,000 cubic feet per day—consisting of two columns 21 inches diameter outside and 13 inches diameter inside and 20 feet high—were erected in place of the old ones, which were in a very bad condition. Two purifiers, 8 feet square by 3 ft. 6 in. deep inside, with two tiers of wooden grids, were erected in the old coal-store, which was adjacent to the two existing purifiers; and, with very little alteration in the walls, all four purifiers are under the one roof. The two new purifiers were fitted with Green's luteless covers, and are connected to the other two, so as to work in any rotation.

A small gasholder tank used as a tar well, and protected by a wooden cover, was re-covered with strong concrete, thus considerably improving our yard space. An overhead tank was erected on two brick piers built on top of the tar well. The tank is filled by a Tangye steam-pump, the overflow going to the tar well. A cart barrel is filled from this overhead tank and carted away to the railway tank-waggons.

The old pumping arrangement was of such an antiquated nature that I think it ought to be mentioned here. The pump was simply a tree trunk, 14 inches in diameter and 22 feet long, with a 4-inch hole bored straight through the centre of the whole length. About 9 inches from the ends, there was a 4-inch hole from the outside to the centre. One of these, the bottom one, was the suction end, where there was a foot valve, and the other was the delivery, and stood about 10 feet above the top of the tank. From a raised platform, and by means of the usual pump handle, two men pumped the tar and liquor; and it was hard work to pump 100 gallons in twenty-five minutes.

The exhauster and gas-engine were put in twelve years earlier, and, consequently, did not require any renewal. There is one little point I would like to mention about the gas-engine. The gas supply for this is taken off at the outlet of the station meter, and should the exhauster ever be pulling too much and drawing in air or furnace gases, it soon affects the gas-engine, and, should the gas become bad, the engine will stop—thus preventing all the gas in the holders from becoming bad.

A new office completed these alterations; and it will be many a long day before the financially harassed Corporation of Lockerbie require to spend much on their gas-works again—providing, of course, there are no accidents.

Now that the gas-works are able to supply any prospective demand that may be made on them, the Gas Committee decided to reduce the price of gas for cooking, heating, and power. They also decided to push gas-cookers by hiring them out on simple hire and at a low rate. As a result of this policy, nearly 60 cookers have been fixed this season, and there are occasional inquiries for others. These extra cookers have now been in use for two months; and in that time the consumption of gas has increased by 13 per cent.

That such complete and extensive alterations were needed is clearly shown by the following figures from the first full year's working of the new works and from the last full year's working of the old works:—

	Year 1907-08.	Year 1905-06.
Gas made, cubic feet	7,569,500	6,825,000
Coals carbonized, tons	735	862
Gas made per ton, cubic feet	10,289	7,917
Coke sold, tons	239	187
Lime used for purification, tons	24	39½

The two extra purifiers proved a great boon during the winter months, and the saving of £13 in lime was as much as would pay 6½ per cent. on the cost of them.

Discussion.

The PRESIDENT (Mr. W. Blair, of Helensburgh) said the members had heard Mr. Cowie's very interesting description of the difficulties and the successes which he had met with in the municipal gas-works at Lockerbie. He had no doubt the Commissioners and the community in general would be very pleased at the results attained during the past year, as they showed that the money spent on alterations and extensions had well repaid them. It was really a bold thing at first for the Corporation to undertake the purchase of gas-works with a make of scarcely 2 million cubic feet per annum. He was afraid some of the members would be looking rather blue if they were capitalized to the same extent as in Lockerbie. He thought the writer was deserving of all praise; and the townspeople should thank him heartily for the efforts he had put forth and the advice he had given them, and also for the ability he had displayed in bringing their gas supply to its successful position. He had been able to reduce the contingent rate, and to bring the price of gas to a reasonable figure; and he hoped that the success he had met with might be maintained and improved. He had no doubt that it would be. It would certainly be ample reward for the labours and exertions Mr. Cowie had put forth to produce these results.

Mr. W. B. M'LUSKY (Perth) congratulated Mr. Cowie on his achievements. The results obtained from the new works were, he said, very creditable. For many years he (Mr. M'Lusky) laboured under conditions exactly similar to those under which Mr. Cowie had worked; and he sympathized with him in his difficulties. While congratulating Mr. Cowie on his large make of gas per ton of coal, he would put to him this point—whether he had analyzed his figures, to see if in Lockerbie a make of 10,289 cubic feet was more economical than a make of (say) 7000 cubic feet per ton. His reason for asking this question was this—in handling a plant such as Mr. Cowie had, his experience was that a make of 7000 cubic feet per ton was more economical than a make of 12,000 cubic feet would be. He had lately found it would be more economical to get 10,000 cubic feet per ton. The difference arose in this way: It was a question whether in the summer time, in small works like these, it was possible to produce sufficient coke to fire the furnaces over the 24 hours, or, to be more exact, over the week. His experience was that the residuary coke produced in the carbonization of all the coal that was required for a make of 10,000 cubic feet per ton was not sufficient to fire the furnaces, and raw fuel had to be used, and that it was better to put this fuel into the retort, and take off a proportion of the volatile matter. Besides a very rich illuminating power, they had more coke for the furnaces. This was a matter which anyone might prove for himself. Mr. Cowie did not state whether the unaccounted-for gas was constant with the large as well as with the small make. After all, it was not so much the quantity of gas they made per ton as what they sold per ton that was of consequence; and they would often notice that where there was a pretty considerable make per ton leakage would be somewhat high. Mr. Cowie's paper dealt with financial results; and they ought to go farther, and ascertain the quantity of gas sold per ton of coal carbonized. There was another matter in connection with small works—the difficulty of getting a very small amount of money. If they considered that in this case probably £15 or £20 would represent 5d. per 1000 cubic feet, the difficulty would be realized. This conveyed to one the idea of how important it was to get small savings, such as 2 gallons more tar per ton of coal, by simply reducing the heats and getting more coke for firing the furnaces, saving the coal for raw fuel for the producers, and obtaining a better net cost per 1000 cubic feet of gas produced. Having made these observations in regard to high *versus* low yields, he would again offer Mr. Cowie his hearty congratulations on his great achievements in lifting the gas undertaking at Lockerbie out of a crippled and bankrupt state, and putting it in a safe position.

Mr. A. YUILL (Dundee) said he did not wish to criticize the paper, because he considered that, to some extent, its nature was such as to make criticism undesirable. They ought rather to convey, not to Mr. Cowie alone, but, if at all possible, to his Commissioners, their appreciation of the work which had been done in Lockerbie; and if they were not themselves satisfied with the results, perhaps an assurance from the meeting that they recognized the good work done by Mr. Cowie would be observed. In considering some of the figures in the paper, he found that they came out pretty well. In those for the year 1905-6 and 1907-8, comparing the new with the old, it was found that while there was an increased make of 2372 cubic feet per ton of coal carbonized, there were also 2040 cubic feet more gas sold; showing, they might take it, that the ratio in the difference of cost remained much the same. This, to some extent, proved the economical methods by which they were working at Lockerbie. Perhaps he might be allowed to mention one point—it was somewhat reminiscent—outside the scope of the paper. When they considered the past meetings of the Association, he thought anyone attending the present meeting would be struck by the fact that young members were now coming forward to take their part in the work of the Association, giving them the benefit of their counsel and advice, whereas before they were only listeners. It was their duty to try to draw out the latent talent—he used the word advisedly, because he knew it existed—which they had in the younger members of the Association. The example which had been put before them that day by Mr. Keillor and Mr. Cowie ought to inspire others to come forward and endeavour to raise the Association to a position worthy of Scotland.

Mr. A. WADDELL (Dunfermline) said he was very pleased to see how successfully Mr. Cowie had come out of the difficulties met with at Lockerbie. It proved to the satisfaction of his own people, of himself, and of the meeting that gas in Lockerbie, when the undertaking was well managed, was bound to be a great success.

The PRESIDENT said he wished to thank the younger members who had read papers. Their proceedings showed that there was talent in the North British Association of Gas Managers, and that, so far as the future of the gas industry was concerned, they who were older might rest content. He hoped those who were, perhaps by a few years, the seniors of those who had come forward that day, would take the hint from what had been done, and come forward, without asking, to read papers at future meetings.

Mr. COWIE, in reply, said, with reference to Mr. M'Lusky's remark about the yield of gas per ton of coal, as it was gas they were selling and gas they wanted to make, he believed in taking as much gas as he could out of a ton of coal. In regard to coke, since the reconstruction of the works he had made much more gas and also much more coke per ton. They required less coke in their producers now than in the old days. He thanked the members very much for the kind manner in which they had received his paper.

At the request of Sir John Brunner, some tests were undertaken at the National Physical Laboratory on the effect produced on mild steel by being embedded in concrete; and the following is the official report of the experiments: "A strong wooden box was made and divided into five partitions, each being 12 inches long, 7⅛ inches wide, and 7½ inches deep. Specimens of mild steel of the following dimensions were prepared: (1) 1 inch diameter and 8 inches long, turned all over; (2) 8-inch lengths cut from a 1⅛ in. by 1½ in. bar with the scale left on. The partitions were half filled with good portland cement concrete, a specimen of each kind laid on the top, and the partitions then filled up. This was done on Dec. 21, 1906. The blocks were covered with water several times a week for a year, and for three months afterwards were left in the open subject to the weather. On April 20 last one of the blocks was removed from the box and broken up, and the specimens removed. On examining them carefully, no trace of any action by the cement could be detected. The turned specimen was practically as bright as when it was put in, and the scale on the rough specimen was undisturbed. To test the possibility of any slight action, the surface of the turned specimen was polished and etched, and examined under the microscope side by side with a specimen of the same material cut from the centre of the bar. No difference in the micro-structure of the two specimens could be detected; and the conclusion is that in 16 months no action has taken place between the metal and the concrete."

A PRIMARY-AIR REGULATOR.

By M. Bromham.

[A Paper read before the Société Technique du Gaz.]

The object of this paper is to show the advantages of regulating the primary air to producers by means of a systematic regulator, over that of having a constant opening of the primary-air slide.

We know that after clinkering the fire-bars of a producer, and after having closed up the furnace, the primary air passes more easily through the bars and produces a considerable quantity of carbon monoxide, which the secondary air does not succeed in utilizing. This excess of carbon monoxide, which goes to the chimney as a pure loss, is continued until the fire-bars, by becoming charged with clinker, reduce the passage of primary air to the point when it is just sufficient to produce the carbon monoxide required to be utilized by the secondary air. From this moment, the combustion of the bed will be practically complete; and we shall see from the diagram, fig. 2, that the clinker increases more and more until the primary air begins to be insufficient, and the contrary to the preceding case results—namely, instead of having carbon monoxide in excess at the outlet of the bed, we now find oxygen coming from the secondary air. This excess of air will have gone through the setting, and have withdrawn heat. It must be agreed by everyone that such working is burdensome.

The object of the primary-air regulator is to regulate the primary-air inlet so that after clinkering, the opening of the slide will be at the minimum, and before clinkering at the maximum. The section of the opening increases proportionately with the formation of clinker. The opening of the primary-air slide is effected as follows: Some strong clockwork mechanism capable of working regularly in the subway of a retort-house turns a light shaft going from one end of the retort-bench to the other. The shaft revolves once during the time between two clinkerings. [This speed can be modified according to requirements, without changing the working of the clock, by simply shifting a wheel.] In front of each bed, the shaft carries a cam, the position of which is fixed by a tightening screw. During its rotation, the cam works a vertical rod, the lower part of which is fastened by a little cord to the primary-air slide. When the cam has made one revolution, the primary-air slide is open at its maximum; and the rod no longer finding any support, falls back again into its original position at the minimum, and the clinkering can be begun. The shaft continues working, and gears again with the slide during the succeeding period; and so it is for the slide of each bed.

The following tables and diagrams show the steadiness of the working of the regulator.

Analysis and Diagram, taken throughout 48 Hours, at the Outlet of a Bed regulated by a Bromham Primary-Air Regulator. Clinkering every 24 Hours.

Time of taking Analysis after Clinkering and Refilling Producer.	First Period of 24 Hours.			Second Period of 24 Hours.		
	CO_2	O	CO	CO_2	O	CO
½ hour after clinkering	17·2	0·2	..	17·6	..	..
3½ hours ,, ,,	17·4	0·2	..	18·0	..	..
7 ,, ,, ,,	17·2	0·2	..	17·6	0·2	..
9 ,, ,, ,,	17·8	..	..	17·8	..	..
11 ,, ,, ,,	17·2	0·2	..	17·4	0·2	..
13 ,, ,, ,,	17·2	0·2	..	17·8	..	..
15 ,, ,, ,,	17·6	..	..	18·0	0·2	..
18½ ,, ,, ,,	17·4	0·2	..	17·8	..	..
21 ,, ,, ,,	17·4	..	..	17·8	0·2	..
23 ,, ,, ,,	17·2	..	..	17·4	0·2	..

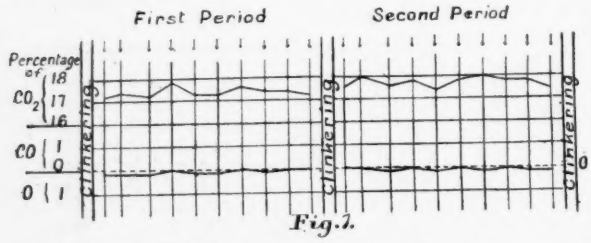

Fig. 1.

It will be noticed in fig. 1 that the amount of carbon monoxide or oxygen remains practically constant at the outlet of the bed. The saving in fuel effected by the regulator during these two comparative tests of 48 hours each was 15 per cent. of the fuel used during the test, as per fig. 2—that is, with the primary-air slide constantly open. The temperature of the retorts was the same in both cases. The adoption of the primary-air regulator avoids the spurts of flame or burning after clinkering. It preserves both the material and the retorts. It equalizes the temperature throughout the period between the clinkerings, and therefore ensures a more regular carbonization and make.

The regulation of it is very simple. To modify the air inlet, all that is necessary is to change by hand a horizontal slide, which just increases or diminishes the section of the inlet, without altering the working of the slide connected to the cam.

The first nine regulators constructed have been working for two

Analysis and Diagram, taken throughout 48 Hours, at the Outlet o a Bed, of which the Primary-Air Slide is constantly open. Clinkering every 24 Hours.

Time of taking Analysis after Clinkering and Refilling Producer.	First Period of 24 Hours.			Second Period of 24 Hours.		
	CO_2	O	CO	CO_2	O	CO
½ hour after clinkering	16·6	..	1·6	16·8	..	1·8
3½ hours ,, ,,	16·8	..	1·4	17·2	..	1·4
7 ,, ,, ,,	17·0	..	0·8	17·2	..	0·8
9 ,, ,, ,,	17·4	..	0·2	17·0	..	0·6
11 ,, ,, ,,	17·6	0·2	..	16·8	..	0·2
13 ,, ,, ,,	17·0	0·2	..	16·4	0·2	..
15 ,, ,, ,,	16·8	0·4	..	16·0	0·6	..
18½ ,, ,, ,,	16·6	1·0	..	17·8	1·0	..
21 ,, ,, ,,	15·8	1·2	..	17·4	1·2	..
23 ,, ,, ,,	15·6	1·8	..	17·0	1·8	..

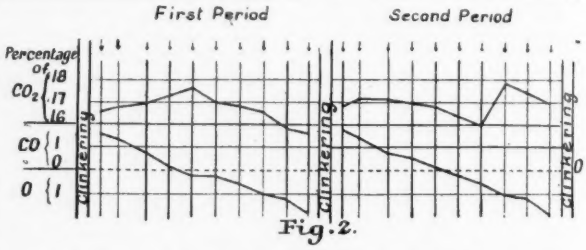

Fig. 2.

years in a Brussels Gas-Works on a bench carbonizing 100 tons of coal in 24 hours. At the Louvain Gas-Works, twelve regulators have been working for six months; and M. Degand, the Manager, states that they have effected a saving of at least 10 per cent. on the fuel used on the old system with the same make of gas. An installation is now being put up at the Forest-lez-Bruxelles works of the Compagnie Continentale du Gaz.

An Early Croll and Richards Patent.

There has lately come to hand a copy of the "Civil Engineer and Architects' Journal" for September, 1844, containing an abstract of the specification of a patent taken out by Alexander Angus Croll and William Richards, both described as of the Brick Lane Gas-Works, for "improvements in the manufacture of gas for the purpose of illumination, and in apparatus used therein and when transmitting and measuring gas." The abstract runs as follows: The first improvement consists in arranging the apparatus so that water may be decomposed by the application of sulphuric acid (which operation is performed in a leaden vessel), the gas evolved from the process being mixed with the fumes or vapour of naphtha, or other proper fluid, for the purpose of giving colour to the light obtained from burning such gas. The second part of the invention relates to a peculiar mode or modes of arranging and fixing clay retorts in an arch or arches whereby the same are said to be more advantageously heated, thereby effecting a considerable saving in fuel in the manufacture of coal gas. The arrangement consists in so combining three arches that they may be heated by two fires, each of the fires being placed under the retorts of the two end or side arches; the centre arch and retorts being heated from the two fires. The heat, after passing over the retorts in the end arches, goes through flues at the lower part and on each side of the centre arch into the same, and, after passing over the several retorts contained in that arch, finally escapes through a flue at the top of the arch. There are two modifications of the above arrangement described and shown in the drawings of the specification, and also another, which consists in a mode of arranging two arches one above another and heated by one fire, which is placed immediately above the crown of the lower arch, the heat from which fire, after having heated the retorts in the upper arch, descends and heats the retorts of the lower arch. The third part of the invention relates to a mode of manufacturing clay retorts, and consists in making them in two parts, the division being in the middle cut traversely. [The method of making the retorts is explained.] The fourth and last part of the invention is for improvements in gas-meters, the principal features of which are the so combining of two flexible partitions that a continuous and uniform stream of gas may be obtained from the burner, and thereby produce a steady flame; and also in the mode of arranging or constructing the flexible partitions in such manner that the leather or other material of which they are made is, in the working of the meter, only bent one way—that is to say, the flexible part is not bent backwards and forwards, which bending has, in a great measure, a tendency to destroy such partitions."

Power Gas Peat.—According to "La Nature," there has recently been installed in Milan an electrical power station, of 2000-H.P., the motors of which are operated by gas produced from peat, of which there is a great quantity in certain parts of Italy. It is stated that from a metric ton of dry peat there are produced 63,570 cubic feet of gas and 121 lbs. of sulphate of ammonia; the power being equal to 480-H.P. hours.

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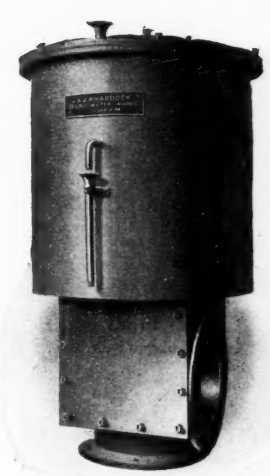

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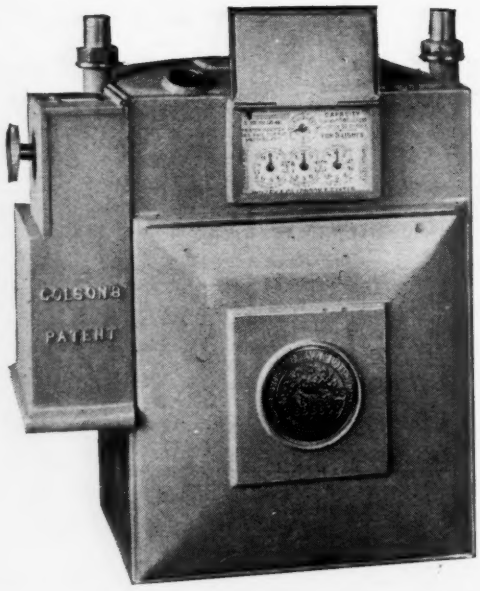

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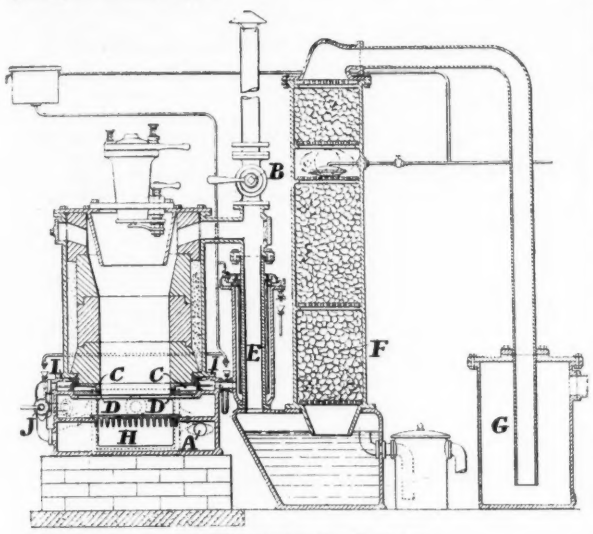
REGISTER OF PATENTS.

Suction Gas-Producers.

CATTEAU, J. B., of Roubaix, France.

No. 12,130; May 25, 1907.

This invention consists principally in mixing intimately the steam and air sent into the furnace and in securing a regular composition for the gaseous mixture obtained, whatever are the conditions under which the apparatus is working—the production of the mixture being always constantly proportioned to the suction of the engine. This is obtained by means of a spraying device or atomizer, in which the water is reduced to a state of fine division, and mixed uniformly, and in regular quantity, with the air drawn in. The gaseous mixture obtained is made more homogeneous still by the heating it undergoes while passing round the gas outlet pipe. The invention consists, in addition, in providing means ensuring the immediate working of the apparatus directly it is started, and also a steady working when lighting the fire or when opening the furnace door.



Catteau's Suction Gas-Producer.

The producer, properly so called, consists of a generator made of refractory earth, surrounded by a cylindrical body of metal—bad heat-conducting material being interposed. The generator rests on a metal base, on which rests an annular ring or chamber of metal C, supporting the refractory earth of the generator and assisting in the production, at the time of starting the combustion and of the opening of the furnace door, of rapid vaporization of the water. Syphons supply the channel or ring with water. At the top of the base is similarly formed another channel I, serving to heat in its passage the mixture of air and steam which, in the normal course, is carried down into the furnace. This mixture passes above and below the grate by two lateral passages controlled by a cock J. The gas produced in the generator flows to the top of the apparatus and thence to an exit pipe E.

The combustible material is introduced into the generator by a hopper (with double doors) above the retort. The doors are both movable in their horizontal plane, and their air-tightness is ensured by springs surrounding metal rods and bearing at their inner ends on rounded washers. A feeding cone or storage bell in the interior of the retort protects the lining of the generator against injury produced by the feeding of the combustible material into the generator.

At the beginning of operations, the combustion of the coal is increased by a fan blowing in the opening A under the grate. The gases of combustion are carried off by the chimney; the cock or regulator B being open to admit of this. When the coal is sufficiently incandescent, some water is introduced (by the syphons) into the steam chamber or channel or ring C, where, on account of direct heating, very quick vaporization is produced—the steam flowing into the generator through holes D. The cock B is then shut, and the liberated gas is sucked away by the motor—passing through the pipe E, the scrubbing tower F, and the expansion chamber G. The air is brought into the generator either by the door H of the furnace or by the spraying device or atomizer, which has not yet been supplied with water, and through the annular channel I.

When the apparatus has worked for a short time in these conditions, and when the gases have sufficiently heated the pipe E, on which is mounted the spray producer, the latter is fed with water, and the cocks of the vaporizing chamber C are shut off. The steam, mixed with air, is then only produced by the spray producer, and is directed, according to the position of the cock J, either over or under the grate, or on both of its faces.

The quantity of the mixture of air and steam produced is thus entirely and directly regulated by the action of the engine whatever be the load of the latter, since it only depends on the reduction of the pressure created by its suction. It is possible, when necessary, to open, during the working of the generator, the door H of the furnace in order to allow of the cleaning of the apparatus without occasioning any stoppage. The vaporization chamber can then be set in operation by being supplied with water during this opening. Steam is then produced, which flows into the generator through the holes D, and is carried up into the generator with the air arriving through the door—no perceptible disturbance of the process of the gas-generator resulting therefrom. Further, the particular arrangement of the air and steam inlets allows the temperature of the furnace to be easily regulated, and, consequently, also that of the grate and of the metallic ring C, and thus ensures their preservation.

Production of Smokeless Fuel.

COWPER-COLES, S. O., of Victoria Street, Westminster.

No. 14,678; June 25, 1907.

To manufacture smokeless fuel from coal and peat, the patentee proposes to take about one-third part by weight of wet peat and two-thirds part by weight of bituminous coal, in a finely divided state, and place them in a retort heated to a temperature sufficiently high (about 850° Fahr.) "to drive off those hydrocarbons that produce smoke;" the generation of the steam from the peat assisting in this operation. The heat is applied for (say) about five hours, at about the temperature mentioned when a furnace is used of the type described in patent No. 27,833 of 1907. The bituminous coal is said to bind the peat together to a coherent mass, and form "a fuel of high calorific value, which is readily ignited in a grate in the ordinary way and burns economically and without smoke."

The retort (provided with relief valves) is arranged to maintain a pressure of 10 lbs. per square inch; and it may be fitted with a plunger to be forced to one end "when the contents are in a plastic state." It is heated externally by burning some of the gases generated after partial purification.

The watery extract—containing tar of complex constitution, pyroligneous acid, and other products, derived from the carbonization of peat in addition to the gases above referred to—is, says the patentee, advantageously condensed and utilized for the production of a pitch of superior quality; and the usual condensible products obtained from the bituminous coal in the retort may be collected and used for any desired purpose.

The contents of the retort after the above-described process has been completed may, it is pointed out, either while still hot or after they have cooled, be discharged into a solution of calcium chloride, by which means the smokeless fuel is rendered slightly deliquescent and always retains a certain quantity of moisture.

Automatically Delivering Bills from Gas-Meters.

GALLAGHER, R. W., of Los Angeles, California.

No. 17,956; Aug. 7, 1907.

The object of this invention is to provide apparatus which can be attached to any meter, and which, when operated by (say) a bill collector, will record the amount of the gas consumed since the last such previous operation, in addition to recording, as heretofore, the cost of the gas at a given rate, and the date of making the record. Furthermore, the invention provides means for insuring that the recording devices are reset to zero after each record has been taken.

A particularly important feature of the invention resides in the provision for automatically rendering a record of the cost of the gas at a price previously determined, as well as the amount consumed. Another important feature consists in the provision of mechanism whereby, though the motion of the meter mechanism is continuous (or practically so), the recording devices, both as to amount and cost, advance only when such amount and cost have reached predetermined magnitudes, as, for instance, exact cents, dimes, and dollars in the cost, and exact units, tens, hundreds, &c., in the amount.

The arrangement is not further described apart from a series of detail drawings and a lengthy (eight page) lettered specification.

Distance Transmission Apparatus for Measuring and Recording Instruments.

SIMMANCE, J. F., of Westminster Palace Gardens, S.W.

No. 18,211; Aug. 12, 1907.

This invention relates to apparatus for transmitting to a distance the indication of any measuring instrument—for length, weight, temperature, pressure, water-level, &c. It does not refer to the measuring or recording instruments themselves, except in so far as they affect or are affected by the transmission apparatus.

The measuring instrument is caused to vary the pressure of air or gas in a vessel (called the "active container"), by any means whereby the pressure is made to vary in accordance with the quantity to be measured. For example, when used with a pyrometer, the active container may be placed in the furnace or other place the temperature of which has to be measured, in which case the variation of temperature causes a variation of pressure of the air in the active container, its volume remaining practically constant. With some other measuring instruments (such as weighing machines, pressure gauges, water-level indicators, &c.), the variation of pressure in the active container is obtained by an alteration of volume. For this purpose, the active container may be a cylinder and plunger, or a vessel with a flexible diaphragm, or the like; the measuring instrument causing the alteration of volume. When used with a water-level indicator, the active container may be an open tube dipping into the water; the water as it rises increasing the pressure of the contained air.

A dummy or "passive container" is placed near the active container, but in such a position that the pressure of the air or gas within it is not affected by the measuring instrument. The two containers are connected by small-bore "transmission pipes," placed side by side, to the two limbs of a differential pressure-gauge or "differential indicating instrument" in any convenient position; and they are connected by a passage controlled by a "communication cock," to be opened or closed at pleasure.

The active container, if of variable volume, has means for setting it temporarily to the same volume as that of the passive container. If now the communication cock is opened, the pressures in the active and passive elements are equalized, and the indicating instrument should

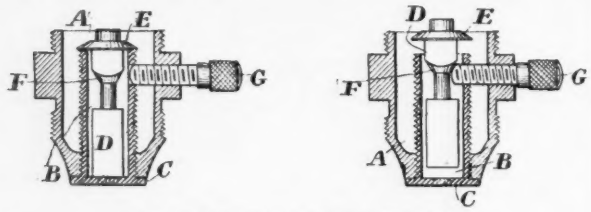
then be at zero. An air-pump and mercury column is used to ensure that there is a standard pressure of air in the system. The communication cock is now shut; and if the total volumes of air in the active and passive elements are equal, any variations of atmospheric temperature cause equal variations of pressure in the active and passive elements; and the differential indicating instrument is not affected. On releasing the active container, and subjecting it to the free action of the measuring instrument, the measurements of the latter are "reproduced at the indicating instrument with practical accuracy."

Gas-Burner Regulators.

WINN, P., and WILKES, A. H., of Birmingham.

No. 21,715; Oct. 1, 1907.

In gas-burners (whether upright, angular, or inverted) the patentees point out that it is necessary, in order to obtain the best results, to have the full pressure of gas at the mouth of the bunsen injector, as illuminating power is obtained by pressure and not by volume of flame. It is, therefore, useless to choke the gas-pressure at the thumb-key or cock of the ordinary bracket; and adjusters or regulators are employed on the burner-tube generally immediately before the mixing-chamber. The object of the present invention is to provide a sensitive and effective regulator, also (preferably combined therewith) means for preventing the passage of the dust into the burner.



Winn and Wilkes's Gas-Burner Regulator.

The illustration shows the device in the closed and open position. The chamber A, which is made in one with the bunsen nozzle, is externally threaded, and preferably shaped at its end after the form of an ordinary nozzle. Inside the chamber a second chamber B is formed, by threading a closed ended sleeve C in from the base of the chamber A. In the chamber B a block D is arranged—preferably square in cross section and with a flat bottom end. It is further provided with a coned hood E at the top, of a size to close the entry to the chamber B and thus deflect dust, &c., into the annular gutter or recess formed by the walls of the chambers. At some distance from the hood, the block is turned down and formed with a taper or conical face F adapted to co-act with the end of the screw G passing through the walls of the chambers so as to cause a raising or lowering of the block.

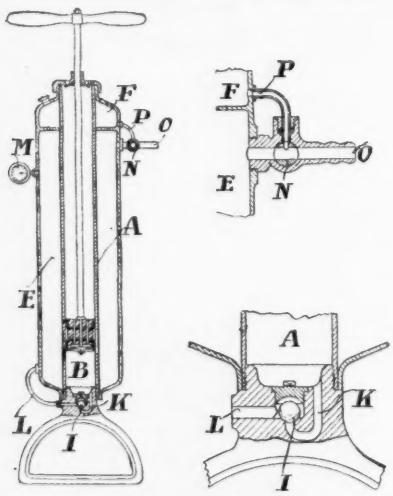
The bottom of the chamber B is provided with holes forming the usual gas-way. The block D in its lower position covers and closes the holes; but as it is raised by the screw it clears same, permitting an adjustment or regulation of the gas-way to suit the particular requirements of the burner.

Cleaning Pipe-Conduits to Gas-Lamps and in the House.

PFEIL, P., of Crefeld, Germany.

No. 26,013; Nov. 23, 1907. Date claimed under International Convention, Jan. 25, 1907.

This invention relates to portable hand pumps in which a dissolvent fluid (benzol or the like) is injected in the form of spray, together with the compressed air that is blown into the pipe, so that stoppages caused by the "naphthalizing" of gas can be got rid of. The air under pressure and the dissolving agent are contained in separate



Pfeil's Pipe-Cleanser.

chambers and conveyed separately to a regulating cock, so that no mixing of the agent and air takes place until the cock is opened and the proportion of air and fluid can be exactly regulated.

The apparatus comprises (as usual) the pump barrel A with a packed piston B arranged on a handle connected with the piston rod; an air holder E surrounding the barrel, and the usual supporting stirrup. The pump barrel and piston are fitted with suitable non-return valves top and bottom, for admitting air to the underside of the piston. A small closed chamber F serves for the reception of a dissolvent fluid, which is introduced through the feed screw above; while in the upper part of the stirrup a non-return valve is arranged. The compressed air produced in the pump barrel on moving the piston is forced through a passage K past the valve I and through a connecting pipe L into the compressed air chamber E. Here the air is subjected to any pressure desired, and which can be seen from the manometer M. The chamber E is furnished with a hose pipe junction O that can be closed by a three-way cock N. In the direction of this cock casing runs a passage P connecting the cock casing with the receptacle F.

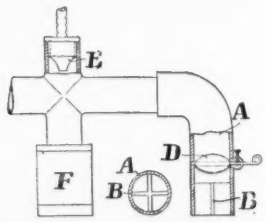
When a pipe is to be cleaned, the air is compressed in the chamber E, and the hose pipe connected with the junction O is inserted in the pipe. The cock N is then opened, and the compressed air that is stored in the chamber E is blown into the pipe to be cleaned. The air at the same time acts suctionally on the fluid contained in the receptacle F, and injects it in the form of spray into the pipe-conduit to be cleaned. In consequence of the cock being a three-way one, the air-current and the quantity of fluid to be mixed with it can be regulated as desired.

Inverted Incandescent Gas-Lamps.

EHRICH and GRAETZ, of Berlin.

No. 4549; Feb. 28, 1908. Date claimed under International Convention, May 1, 1907.

This invention is intended to provide an arrangement for the conduction of the air to the mixing-tube of an incandescent burner—an angle-shaped conduit pipe with a downwardly bent open end divided into several channels and provided with a regulating device consisting of a revolvable butterfly valve.



Ehrich and Graetz's Inverted Lamp Burner.

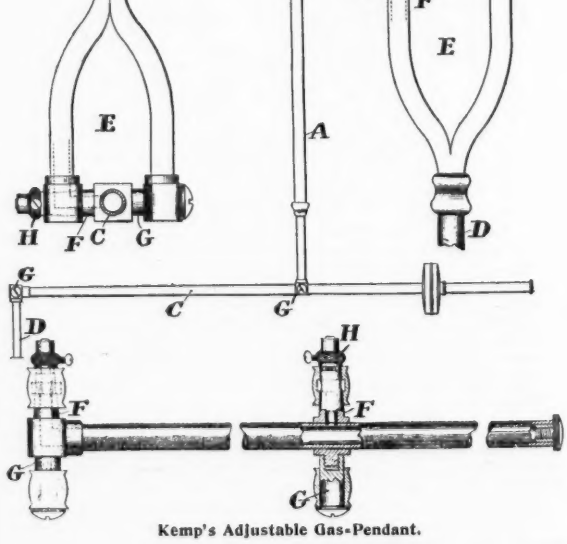
Gas enters by the nozzle E, and air is led to the mixing-chamber by the pipe A provided with a downwardly inclined open end. At the mouth of this open end B, cross walls are arranged to divide the air conduit into four channels. Above the cross walls is a butterfly valve D, which may be rotated into any desired position and held there by any suitable means. In this way, gas is led from the nozzle E and air through the conduit pipe A into the mixing-chamber F "quietly and regularly under all conditions."

Adjustable Gas-Pendants.

KEMP, C. W., of Birmingham.

No. 8473; April 16, 1908.

This invention relates to a gas-pendant of the "Surprise" type, in which a suspended counterpoised beam carries at one end a swinging drop from the lower end of which is fitted a burner, as described in



Kemp's Adjustable Gas-Pendant.

patent No. 6907 of 1893—in one form with a double-armed beam, and in another form with a single-armed beam. The present invention relates to the single former type.

The illustration shows a side elevation of the greater part of such a pendant; a horizontal sectional elevation on a larger scale; and end sections, also on the same larger scale.

One part of the invention consists in the way the two drops A and D are connected to the single-armed beam C, so that a "central suspension and true vertical line" of these parts always results. Where the ceiling drop and the burner drop connect with the beam C there are a special fork and fulcrum joint, both of which are alike. From the single drop tube proceed two tubular branches of a fork E arranged centrally of the drop tube, and so that the branches are substantially rigid—one only having a gas-way through it. The terminations of the branches are provided with transverse separate sockets screwed on to the ends of the branches so that their interior bores are oppcsite and exactly in a line across the mouth of the fork E. The beam C is a single length of tube carrying rigidly upon it two conical gas-plugs F, one at the end and one about the middle. The plugs are carried by blocks securely attached to the tube forming the single-armed beam, and which upon their opposite ends to where the plugs are provided are formed with screwed studs exactly in line with the plugs. The tube of the beam C is secured to the middle block by very tightly fitting a hole in it. This obviates soldering or brazing, and permits of the beam being made of one piece of tube.

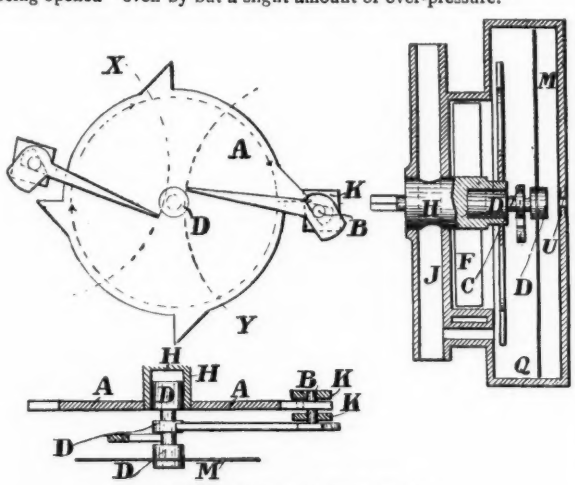
G is a rotatable plug fitting the bore of the socket and adapted to screw on to the screwed stud on the block in a manner providing one of the trunnions of the fulcrum joint, and permitting of the joint being easily assembled. In assembling, the conical plug F is first of all introduced into its socket and properly pulled in so as to seat itself by a screw nut H; the gas-way between the drop and the beam being through this plug and the branch carrying the socket, into which the plug fits. The plug is now inserted into its socket, and is screwed on to the stud and the fulcrum joint is complete, and "is well supported at both sides of the beam, and quite central."

Lighting Devices for Street Gas-Lamps.

SCHUBERT, O., of Charlottenburg, near Berlin.

No. 9763; May 5, 1908.

This invention relates to gas-lamp lighting devices of the class in which an alteration of the gas pressure affects a diaphragm, which causes the release of a ratchet cock-controlling contrivance—the cock being opened "even by but a slight amount of over-pressure."



Schubert's Lamp Lighting Device.

The illustrations show a front elevation of the ratchet-wheel mechanism with the case removed; also a vertical and a horizontal section through the device.

The plug H of the gas-cock is actuated by a spiral spring F, which always tends to turn the plug in a definite direction. Mounted on the plug is a ratchet-wheel A, the detent mechanism co-operating with which is controlled by a diaphragm M. The gas flows from the pipe J through a small connecting-pipe into the chamber Q of the case (in which is the diaphragm M), forming a gas-tight partition. On the gas pressure increasing, the diaphragm is forced in the outward direction, and thus axially shifts the sliding pin D to which it is secured. The air driven out of the back space escapes through the outlet U in the case wall.

The detent mechanism for the ratchet-wheel consists of the pin D sliding through the centre of the wheel A and furnished with a collar or shoulder and grooves at the sides; also two pairs of levers, one of which is carried by a pivot B mounted in bearing-cheeks K of the case. The nose of the short lever constitutes a pawl, which engages with the teeth of the ratchet-wheel A and regulates its rotation; while the nose of the long lever bears against the collar of the pin D. On increase or decrease of the gas pressure, the pin is axially advanced or retracted, owing to the movement of the diaphragm M. On sliding in the one direction, the pin will present its groove to the nose of the long lever, which, being thus deprived of support on the part of the collar, swings downwards in the direction Y. On the pin sliding in the opposite direction, the collar is again brought into the path of the lever. The second pair of regulating-levers is at the opposite side of the wheel A, somewhat out of alignment with the levers.

Suppose the pressure to increase, the diaphragm M will be forced outwards and axially shift the pin D, so that the groove in it will be presented to the nose of the long lever, which can thus swing downward in the direction Y. At the same time the nose of the detent B releases one tooth of the wheel A, which will thereupon be rotated by the spring, until the other tooth strikes the detent which is coupled with the shorter lever. Since the nose of this latter lever bears against the collar at this moment, further rotation of the wheel A is checked.

Assume, now, that the gas pressure is diminished, the pin D will be axially shifted back into its initial position by the diaphragm M. The short lever will swing up in the direction X, while the collar will be presented to the longer lever, so that the latter will be arrested.

The levers are caused to return to their positions of rest automatically by being counterweighted; and they are so mounted that they can swing in both directions. This admits of the wheel A turning freely backward, as is necessary on winding up the spring after it has run down.

Incandescent Gas-Mantles.

WHITE, A. P., of Caldwell, N.J., U.S.A.

No. 3055; Feb. 11, 1908. Date claimed under International Convention, Nov. 16, 1907.

This invention is said to afford efficacious means of overcoming the liability of breaking when burning off mantles made of artificial silk, and, at the same time, of producing a coated mantle capable of being crumpled without causing fractures to appear when the collodion coating is burned away.

This is accomplished by superimposing upon the burned-out oxide structure made of artificial silk, what, for convenience of description, the patentee designates as a second mantle—that is to say, he builds up over and about the original mantle what is practically the equivalent of another mantle, to reinforce the first one. The second mantle, enveloping the first, goes into the market with the incandescent material unburned; and "this material being unburned, the second mantle serving as a cover is practically, in character, an unburned impregnated web." For the same reason that an ordinary unburned impregnated web can be handled, the thing thus created can also be crumpled, because the added incandescent salts have not yet taken the friable oxide form which results from the application of the heat. It will thus be seen that one has a completed mantle of oxides, serving as the core of an incomplete one, or, again, one provided with a medullar sheathing taking the same nature as the original oxide structure when the article is put into service. In other words, "there is effected in this way a mechanical combination of an oxide and a salt, which salt becomes an oxide at the desirable and convenient moment—*i.e.*, when the mantle is put in service."

In practice, the reinforcing material can either be applied after the mantle has been covered with a protecting coating, or at the time of applying the protecting coating—preferably after the mantle has been coated. To a given quantity of thorium nitrate is added about 1 per cent. of cerium nitrate, and with this mixture an aqueous solution is made (using carefully prepared distilled water) of a density of about 6 per cent. The coated mantle remains in the solution only long enough for the fluid to penetrate the structure. It is then dried in ordinary temperatures; no heat being necessary unless to expedite drying.

Care should be taken, the patentee points out, not to make the solution of too high a density, else the presence of the greater proportion of nitrates will tend during the burning-off of the protecting coating to cause it to burn with deflagration. All danger of this, however, can be avoided by making a special solution partly denitrated, in the following manner: To a given quantity of thorium nitrate add 1 per cent. of cerium nitrate, and with this make a 50 per cent. aqueous solution. To the solution add as much thorium hydrate as the fluid will dissolve. Care is not required in determining the quantity of hydrate, for any excess added will settle as a precipitate, from which the saturated fluid is easily decanted. The hydrate precipitate remaining is reserved for the preparation of the next lot.

Almost any coating formulæ, having soluble gun-cotton as the base, are available for providing the coating for the mantle. That said to be best adapted is made as follows (weight representing the division of the parts): Dry gun-cotton, 6 parts; methylated spirits (wood alcohol), 50 parts; ether, 27 parts; alcohol, 30 parts; amyl-acetate, 10 parts; acetone, 30 parts; camphor, 3 parts. To the whole add 1½ per cent. of castor oil. Thin to the desired consistency with a solution composed of 4 parts methylated spirits and 1 part amyl-acetate.

The reinforcing substance may be incorporated in the volatile solution into which the mantle is dipped, in order to form on it a protecting coating. In this case there are introduced into alcohol, the metallic salts, preferably thorium nitrate and cerium nitrate in the proportion of about 1 per cent. of cerium nitrate to about 99 per cent. of thorium nitrate. A mixture is made of half nitrates and half alcohol, and then a coating solution consisting of 6 parts by weight of gun-cotton, 50 parts of methylated spirits (wood alcohol), 30 parts of alcohol, 10 parts of amyl-acetate, 30 parts of acetone, 5 parts of camphor, 27 parts of ether; and castor oil is added to the extent of 1½ per cent. of the whole. To this solution the alcohol and nitrates of thorium and cerium are added in such proportion as to have the nitrate preferably constitute about 5 or 6 per cent. of the whole. The solution is thinned to the desired consistency with a solution composed of 4 parts of wood alcohol and 1 part of amyl-acetate, to which also has been added the alcohol containing the cerium and thorium nitrates in quantity sufficient to make the alcohol compound constitute 10 per cent. of this mixture. The oxide structure formed by burning out the fibre is dipped in the preparation described, and as the volatile constituents pass away, there is formed on the mantle a coating containing the additional incandescent material.

Socialistic Municipal Trading.—The following is culled from last Thursday's "Western Mail:" "It is Socialism in the concrete that provides the true object-lesson. Yesterday at Newport the Education Committee had before them estimates for lighting one of the schools. The gas estimate was £26 10s.; that for Corporation electric light, £70. One of the Socialistic municipal trading members expressed the view that the acceptance of the lower tender need not necessarily follow—that the quality of the light and the fact that it was supplied by the Corporation ought to count. Luckily, this view was not allowed to prevail."

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Refractory Material.

SIR,—I should like to be permitted to inform your various correspondents, and other gentlemen interested in the above subject, that the President of the Institution of Gas Engineers (Mr. Thomas Glover) authorizes me to say that, if he is approached formally by representatives of the manufacturers, he is quite willing to lay the matter before the Council of the Institution, with a view to the appointment of a Joint Commission to consider the whole question of the supply of refractory material to the gas industry. The manufacturers themselves having also expressed their willingness to join in such an inquiry, there seems to be no doubt that it will take place. Apart from the consideration of such matters as have been under notice of late, the useful work which such a Commission might do is very extensive; and the interchange of views cannot but be fraught with the greatest benefit to all concerned. If there are shortcomings, they certainly are not all on one side; and free and open discussion of both cases can only be obtained in this way. I would also suggest that such an occasion would prove a convenient opportunity for bringing forward that old and difficult question, the standardization of retort sections.

As there is every prospect of the Joint Commission being appointed, it seems very undesirable to further discuss the matter here. There being, however, I believe, a little soreness among some of the manufacturers at my reference to certain of their methods (partly, I think, due to the fact that some well-meaning critics have applied to my remarks the epithet "scathing"), I should like to take this opportunity of assuring them that those parts of my paper were not written with any captious or cynical intent, but rather to call attention to the urgent demand for the general production of a better-class material, the supply of which will probably pass into other hands unless the splendid raw material available to our manufacturers is subjected to thorough scientific investigation, and the most made of it. It was quite impossible to call attention to the matter in any other way. That in the great majority of cases the methods of investigation now in vogue are either absolutely unreliable or unscientific, I do most emphatically believe; and if the proposed Commission find this contention to be well founded, and are able to point the way to a better state of affairs, they will achieve a very great work.

Although I have already deprecated further correspondence on the matter, I may say, in reply to your correspondent Mr. W. P. Gibbons (*ante*, p. 177), that the costs given in my paper are *actual* figures for various works carbonizing nearly three-quarters of a million tons of coal annually, and include all charges incurred in the repair and maintenance of retort-settings also. The wording of my paper may be ambiguous as to the inclusion of labour; but the latter forms so considerable a proportion of such charges, that it is quite impossible to discuss the matter unless it is included. The figures given—viz., 4d. and 10d.—are the limits for both types of settings; and the latter figure includes inclined retort-settings also. Were not my letter already a very lengthy one, I would willingly become a critic of the *hypothetical* figures he submits. I may, however, say, in passing, that one serious omission from his statement of costs is the absence of any items for material and labour for repairs during the 100 odd days every year when his settings are not at work. To repeat the inquiry of Mr. Douglas Helps at the Institution meeting, "How much of the original retorts is left at the end of their life?" and where are the charges for their maintenance and repairs?

F. J. BYWATER.

Birmingham, July 25, 1908.

Mr. Bywater's Paper on Refractory Material.

SIR,—It is to be inferred, from what appeared in the "JOURNAL" for the 14th inst., that the suggested conference between gas engineers and fire-brick manufacturers, arising out of Mr. Bywater's bold and trenchant contribution to the subject of refractory material published in your issue for the 23rd ult., is either relegated to a remote date, or is possibly now a doubtful contingency. May I say, with respect, that it is not a simple matter to see how such a conference could serve any fruitful purpose, or do more than accentuate the expression of widely conflicting opinions.

Still, it ought to be said that the fire-brick industry in this country is not conducted, in any widespread degree, in the crude and drowsy fashion a perusal of the paper would indicate. A fire-brick yard does not, perhaps, lend itself to those showy evidences and springs of improvement which operate in many trades; yet it is a fine field for the best brains and the highest skill, and in so far as Mr. Bywater urges this as an immediate necessity, nothing but good can result. In this connection, it is at least significant that the author himself, as a progressive gas engineer, has no word of approval either for machine-made bricks or for machine-made retorts; and, strange as it may appear, in this particular business, some of the most enlightened men, thoroughly acquainted with the technicalities and practice of fire-brick manufacture, could easily write an elaborate defence of the position he thus takes up.

On the other hand, the specific allusion to machine-made retorts needs some correction, especially if the paper is to be held as a document of reference, as was suggested in the subsequent debate. The mere length of time occupied in the making of retorts by hand processes, as against the quicker machine manufacture, could not, in my view, make any appreciable difference in their respective life. It would be infinitesimal and impossible to weigh. The real *crux* is between the employment of plastic and semi plastic clay. Again, "the heavy pressure requisite for the manufacture of machine-made retorts" need not "cause the texture to be too close and compact;" and certainly it is not a process which forbids a coarse-grained material, which is so desirable. As to tempering, the retort maker who charged his machine with badly-tempered clay would in that act be the worst enemy to himself.

What are gas engineers asking for? That is the most important question starting out of this paper. Is a retort having a life of from 2000 to 2500 days the urgent and widely-felt want of the gas industry? Then it involves an experiment of such duration that every preliminary day lost before its commencement is of consequence. I should be willing to give three retorts apiece, made to any section, to any two or four gas engineers who would be sufficiently interested to run a bench with this want and test in view. If the offer were accepted, the following points should be noted:—

(1) The three retorts would differ from anything hitherto supplied, and differ from each other in their composition.

(2) They would certainly run an average life.

(3) With great distinctness, they would be made specifically for this test as the outcome of a fairly ripe experience, and as the result of investigations similar in character to those pursued by Mr. Bywater.

(4) They could be run concurrently with retorts from other makers to complete the beds.

As to whether they would succeed, and stretch out the abnormal term, years would determine. But, as Dr. Colman very properly observed, the various methods of treatment of fire-clays were the province of the fire-brick manufacturer, and "impossible to be undertaken in ordinary gas-works." So fire-brick men could hardly set up a bench of retorts as a little testing game for 2000 to 3000 days.

Broadly, Mr. Bywater's paper is a clear and ably-conceived contribution to the subject on which he writes. He strides into a world of work sufficient for the entire powers of any man; and it is no disparagement to say that occasionally he reflects the beginner. However, the effect of the paper is stimulating. It will help to keep an old industry awake and vigilant. That is a real gain; and the "vast interests involved" will share it.

ALBERT CLIFF.

Stamford, July 21, 1908.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills reported, with amendments: Blackburn Corporation Bill, Burnley Corporation Bill, Gosport Gas Bill, Holderness Water Bill, and Manchester Corporation Bill.

Bills read the third time and passed: Blackburn Corporation Bill, Burnley Corporation Bill, Criccieth Water and Improvement Bill, Liverpool Corporation Bill, Manchester Corporation Bill, Margate Corporation Bill, Padiham Urban District Council Bill, and South-West Suburban Water Bill.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Lords Bill read a second time and committed: Rhymney and Aber Valleys Gas and Water Bill.

Lords Bills reported, with amendments: Gas Orders Confirmation Bill, Gas and Water Orders Confirmation Bill, Keighley Corporation Bill, Rhymney and Aber Valleys Gas and Water Bill, and Wath and Bolton Gas Board Bill.

Lords Bills read the third time and passed: Gas Orders Confirmation Bill, Gas and Water Orders Confirmation Bill.

PROVISIONAL ORDERS PROCEDURE BILL.

This Bill, which is to enable rules to be framed regulating the procedure with respect to Provisional Orders made by the Board of Trade and the Local Government Board, and for other purposes, was considered by the House of Lords in Committee last Tuesday. Lord Hamilton of Dalzell, on behalf of the Board of Trade, submitted an amendment to sub-section 2 of clause 1 of the Bill. As originally introduced, the sub-section ran as follows:—

> Any rules made in pursuance of this section shall have effect as if enacted in this Act, and shall be laid before Parliament within three weeks after they are made, if Parliament be then sitting, and if Parliament be not then sitting, within three weeks after the beginning of the next session of Parliament.

For this the following sub-section has been substituted:—

> Any rules made in pursuance of this section shall be laid before both Houses of Parliament as soon as practicable after they are made; and if either House of Parliament within the next forty days after any rules have been so laid before that House resolves that the rules or any of them ought to be annulled, the rules or those to which the resolution applies shall after the date of such resolution be of no effect, without prejudice to the validity of anything done in the meantime under the rules or to the making of any new rules.

As introduced, the Bill only applied to the Board of Trade. As amended, its provisions extend to the Local Government Board; and the first schedule, in which are specified the enactments under which applications for Provisional Orders may be made, has been amplified by the inclusion of the Public Health Act, 1875 (38 & 39 Vict., cap. 55, sec. 161). The Bill, as amended, was reported on Thursday.

GAS ORDERS CONFIRMATION BILL.

The Unopposed Bills Committee of the House of Commons, presided over by Mr. CALDWELL, had before them on Thursday the Bill promoted by the Board of Trade to confirm a number of Provisional Orders granted under the Gas and Water Works Facilities Act, 1870.

Mr. BONNOR-MAURICE, who appeared in support of the Bill, said the first Order was one to empower the Caldicott and District Gaslight and Coke Company, Limited, to construct new works. The share capital authorized to be raised was not to exceed £7500. Mr. Moon (Speaker's Counsel) had pointed out that there was no limit to the dividend payable, and a new clause had therefore been inserted in the Bill limiting the dividend to 10 per cent.

Mr. MOON said that in the other Orders the dividend was limited to 10 per cent., and he thought it advisable it should be so in this case.

The clause was accepted.

Mr. BONNOR-MAURICE further stated that the Company were to have the usual borrowing powers of one-third; interest on borrowed money not to exceed 5 per cent. Gas was to be of 14-candle power. The maximum price (5s. 6d. per 1000 cubic feet) had been agreed between the undertakers and the Urban District Council.

Mr. MOON: And it is subject to revision at the end of three years?

Mr. BONNOR-MAURICE: Yes; there is power to the Board of Trade to alter it, or to provide a sliding-scale after three years.

The next Order was one to authorize the construction and maintenance of gas-works in the parish and urban district of Rainford, in the county of Lancaster, by certain persons who, before putting into operation any of the powers conferred by the Order, must transfer the undertaking to a company, such transfer not to be valid until it had received the approval of the Board of Trade. The capital was not to exceed £8000; and the dividend was limited to 10 per cent. The gas supplied was to be of 16-candle power. The price was to be 4s. 6d. per 1000 cubic feet; and there was provision for a sliding-scale.

Mr. MOON: There is provision for the future purchase of the undertaking by the Council. This, however, does not give the Council power to purchase; they require to be duly authorized first.

The third Order proposed to enable the Rothwell Gaslight Company to purchase additional lands and to construct further works. The price was to be reduced from 4s. 9d. to 4s.

The next Order was intended to empower the Tenterden District Gas Company, Limited, to maintain and continue gas-works to supply gas in the borough of Tenterden, and to raise additional capital. The original capital of the Company was £6900, and power was sought to raise £3300 more.

Mr. MOON: Clause 10 wants explanation. There you depart from the ordinary practice of giving 10 per cent. on the original capital and 7 per cent. on the new, and give 7½ per cent. all round.

Mr. BONNOR-MAURICE: Yes, that is to some extent a compromise.

Mr. H. C. HONEY (representing the Board of Trade) said an agreement on the point had been arrived at between the promoters and the Local Authority. The former undertook to limit the dividend, which might have been 10 per cent. on the original capital, to 7½ per cent. Then they applied to the Board of Trade that, instead of the additional capital being 7 per cent., it should be 7½ per cent.; and, as a matter of convenience, the Board of Trade acquiesced.

Mr. BONNOR-MAURICE: Clause 12 I understand is to be struck out. It provides for a renewal fund which is not applicable in this case.

Mr. BEALE (Member of the Committee): Why is it not applicable?

Mr. MOON: Because this is a maximum-dividend Company as distinguished from a sliding-scale Company.

The clause was accordingly deleted.

Mr. BONNOR-MAURICE added that the price authorized for gas was 4s. 8d. per 1000 cubic feet.

The next Order authorized the construction and maintenance of gas-works and the supply of gas within the parishes of Headley, Kingsley, and Selborne, in the county of Southampton. The capital was not to exceed £8000; and the dividend was limited to 10 per cent. The gas was to be of 16-candle power, and the price 5s. 3d. per 1000 cubic feet.

The Bill containing these Orders was then passed.

GAS AND WATER ORDERS CONFIRMATION BILL.

This Bill came before the Unopposed Bills Committee of the House of Commons, presided over by Mr. CALDWELL, last Thursday. The object was to confirm certain Provisional Orders made by the Board of Trade under the Gas and Water Works Facilities Act, 1870.

Mr. BONNOR-MAURICE said one of the Orders proposed to empower the Earby and Thornton Gas and Lighting Company, Limited, to raise new capital not exceeding £10,500, but subject to the provision that the total of the new and old capital should not be more than £20,500.

The CHAIRMAN: The preference capital is 6 per cent.

Mr. HONEY: Though usually the preference dividend is limited to 5 per cent., this is an existing Company who already have power to raise 6 per cent. capital. I think, therefore, it would be more convenient to leave them the same power now. Until quite recently it was customary to allow 6 per cent. in Provisional Orders.

The CHAIRMAN: I do not see why, when giving power to raise large capital, it should be 6 per cent.

Mr. HONEY: I do not think there is any objection to making it 5.

The CHAIRMAN: Very well.

Mr. BONNOR-MAURICE: Then you will substitute "five" for "six." Continuing, he said the price was to be 4s. per 1000 cubic feet, and there was a sliding-scale in the usual form.

The next Order was one to enable the East Hull Gas Company to alter the method of ascertaining the quality of gas. The candle power was 14. The price of gas in East Hull was 2s. per 1000 cubic feet.

The Bill was allowed to proceed.

THE POTTERIES FEDERATION SCHEME.

The Select Committee of the House of Commons presided over by Sir GEORGE WHITE, gave their decision last Tuesday on the Local Government Provisional Order (No. 3) Stoke-upon-Trent Bill (see *ante*, p. 181).

The CHAIRMAN delivered the judgment of the Committee as follows: The Committee consider the preamble for federation proved, and therefore the Order is confirmed, subject, however, to certain important changes which, in the opinion of the Committee, are needed to make the Provisional Order equitable. First as to the Valuation Committee, sub-sections 3 and 4 of article 25 of the Provisional Order, we shall require a sub-section substituted for these, which shall provide for a Valuation Committee to consist of twelve persons, two from each authority, these twelve persons to select from outside the area a Chairman, who may be paid for his services, who shall have a casting vote only if on any division there is an equality of votes. If the Committee fail to agree in their selection, it shall be left to the Local Government Board to appoint. This Committee may call expert witnesses; but Counsel shall not be heard. Secondly, in regard to assets and liabilities, in calculating assets, floating capital and floating assets generally shall be taken; also gas and electricity works, sewerage works, halls, and public buildings and parks, but not street widenings, street improvements or paving. On the other side, all outstanding liabilities. Thirdly, the principle of differential rating shall be provided which shall run for a term of ten years. Fourthly, article 5, sub-section 1, Coroner's officers to be left as at present during the official life of the present holders. Fifthly, when gas or electricity undertakings reach the figure of profit of 5 per cent., all receipts beyond that percentage shall go in reduction of the price to the consumer. These are the important changes which we think should be made in the Order.

Mr. RAM said the promoters would bring up a sub-section to satisfy the wishes of the Committee.

Mr. HONORATUS LLOYD, on behalf of Stoke, said that they would not take part in the discussion of clauses. They reserved themselves for another place.

The further proceedings were adjourned till yesterday.

When the Select Committee resumed their sittings, a number of amendments, which were brought forward by the promoters for the purpose of carrying out the decision of the Committee, were considered. The most important one affecting matters relating to gas and other undertakings was a long clause with regard to the appointment of the Valuation Committee. This amendment, as Mr. Ram pointed out, was the machinery necessary to enable the Committee to do their work, and was to the effect that the members of the Committee should be nominated by the six Councils; and if any of them should fail to nominate members, the Local Government Board should appoint. The Chairman remarked that the amendment seemed to carry out the wishes of the Committee in the matter. It was also decided that 5 per cent. of the amount at which the separate undertakings were valued under Article 25 of the Order, together with any capital expenditure by the Corporation or the combined gas undertaking, should go to the relief of the local rates.

PORT OF LONDON BILL.

The Position of the Gas Companies.

The Joint Committee of both Houses of Parliament presided over by Mr. RUSSELL REA had the Port of London Bill (*ante*, p. 178) again under consideration last week.

Mr. HONORATUS LLOYD, on behalf of the South Metropolitan, the South Suburban, and the Commercial Gas Companies, moved an amendment to clause 36 to put the River Lea in the same position as the Rivers Swale and the Medway under the saving clause with regard to charges on vessels and goods passing through the Port of London. When Sir Llewellyn Smith, representing the Board of Trade, was in the box, he (Mr. Honoratus Lloyd) cross-examined him as to whether or no it was the intention of the promoters to levy dues on goods which simply passed through the Port of London and were not dealt with in any way in the port; and the reply, in effect, was that it was not the intention to levy dues on goods which, without being landed or unshipped in any form, passed through the limits. He (Mr. Honoratus Lloyd) added on that occasion, "under no circumstances;" and the answer was, "I do not think under any circumstances." The Chairman subsequently remarked: "I suppose the principle which applies to the River Medway and the River Swale will also apply in the River Lea." Then Sir Llewellyn Smith observed that he was not quite sure about the position. He (Counsel) then put his special case; and the witness said: "If I find I have incorrectly stated it, I will alter it. . . . In general I should not intend that the words 'goods imported into the Port of London' should be held to cover goods carried right through the Port of London to some other place without disembarking." In re-examination, Sir Llewellyn took the view that the Rivers Medway and Swale were in a different position from that of the River Lea. Apparently the line the witness took was that he would differentiate between the Medway, the Swale, and the Lea; and the excuse he offered for the presence of the clause in favour of the Medway and Swale was that it existed in 1903. This was good enough as far as it went, no doubt; but the River Lea should be in the same position. The observation that fell from the Chairman showed that, *primâ facie*, at any rate he (the Chairman) thought his (Counsel's) case sound, and that there was no ground for differentiating between the two. It might be said that at the time the Chairman was not fully aware of all the circumstances; but he (Counsel) had carefully guarded himself by putting to the witness the specific case he had in mind—namely, the case of coal imported coastwise having to pass through the Port and being disembarked on the River Lea. In these circumstances, he submitted that the clause should really carry out what the promoters

evidently intended by their marginal note, because, although the marginal note formed no part of the section for construction purposes, it did not show what the promoters, who prepared the marginal note, had in their minds. The marginal note was "Saving for vessels and goods passing through the Port of London." As it stood, the saving was limited to such goods "on a voyage between places situate on the River Medway or the River Swale, and not within the Port of London and any other places not within that port." There was no ground for differentiating between the Medway and Swale on one side and the Lea on the other; and those goods which were carried through the port by force of circumstances and discharged on the Lea should be in the same position as those which were discharged on the Medway and Swale.

Mr. COOPER, on behalf of the Wandsworth and Putney Gas Company, said he had a clause almost in similar terms, and proposed to call evidence later on. But in consequence of what was raised now, he thought it would be more convenient if he intervened.

Mr. J. D. FITZGERALD (for the promoters): Mr. Cooper's clause is in a different form; but the object is the same. The object of his clause is to exempt vessels going to the wharf of the Wandsworth and Putney Gas Company; and the object of the clause is to exempt vessels going to the wharf of the Commercial Company. The two clauses have exactly the same object, although the form is entirely different. The Wandsworth and Putney Company's wharf is above bridge.

The CHAIRMAN: It has nothing whatever to do with the Lea.

Mr. FITZGERALD agreed.

Mr. COOPER said it was not on the Lea; but to get to it one passed through the Port of London.

The CHAIRMAN: I think it would be better to take the two amendments together, because the same principle may apply.

Mr. COOPER said that under the Thames Conservancy Act, 1905, the Conservancy were authorized to double the tonnage dues then levied on such vessels as might pass up to his Company's wharf. The period during which the Conservancy could raise this increased toll would expire on Jan. 1 next. The Bill, however, would make the toll permanent. In addition, the Bill proposed to levy, for the first time, a toll or dues on coal.

The CHAIRMAN: It does not, as a matter of fact. What is your broad point?

Mr. COOPER: My point is that, although you have said this is not to be made a dearer port, as a matter of fact, affecting my particular Company, it may be a dearer port. It is under the Bill subject for ever to an increased toll which expires, under the existing arrangements, on Jan. 1, and for the future it is to be subjected to a toll to which it is not subject now.

The CHAIRMAN: These are general considerations which apply to the Port of London. Are there any special considerations applying to your wharf?

Mr. COOPER: I derive no benefit from the expenditure which you are exacting from me. The registered tonnage of my vessels is about 600 tons. I do not benefit from any improvement of the waterway of the Thames, or from the use of the docks.

The CHAIRMAN: These are old arguments which we have heard from the short sea traders. We want to know the special circumstances which apply to your wharves which put you in line with these applicants connected with the Lea.

Mr. COOPER: My circumstances are somewhat different from those of the short sea traders, in that my profits are limited by Act of Parliament. I am fixed on a standard scale for division of profits. If any additional burden is put upon my shareholders, my dividends have to go short, or I have to put up the price to my consumers.

Mr. HONORATUS LLOYD: I object to my clause being prejudiced by this.

The CHAIRMAN: I think we may negative this altogether. We refuse to make any exception; but the case of the Lea is distinct.

Mr. FITZGERALD said that though the case of the Lea was different, the object was exactly the same. The Medway contained Sheerness, Queenborough, and Rochester; and ships which were going to these places did not do London trade. It was only by extending the limits of the port that the Medway traffic was brought in, and accordingly, when traffic was *bona fide* going to the three towns mentioned, it was not proposed to impose a due on it. But this was not to apply if goods were landed anywhere in the Medway and transhipped and sent to London. In such cases, the dues were to be paid; and the Medway people were quite satisfied with this. Then Mr. Lloyd came along with a proposal to exempt from dues all traffic going to the River Lea—the eastern boundary of the county of London. The wharf of the Commercial Gas Company was on the Lea; and the object of Mr. Lloyd's clause was precisely the same as the object of Mr. Cooper's clause—namely, to exempt from any tolls on ships or goods the traffic of the Commercial Company. He submitted that on no ground whatever ought traffic going to the Lea to be exempted.

The CHAIRMAN: We cannot make any exception in respect of the River Lea.

Mr. HONORATUS LLOYD, on behalf of the Gas Companies he represented, proposed a series of amendments to the clause which provides for an election of the elected members of the Port Authority every third year. The object of the amendments was to direct that a third of the members should go out of office each year. Mr. Thorne, of Liverpool, when under examination, said he thought that the principle of the amendments was better than the principles of the clause, and that it had worked well in Liverpool. It was worthy of the consideration of the Board of Trade.

Lord MILNER (a Member of the Committee): It is to give more continuity in the body?

Mr. HONORATUS LLOYD: Yes; it prevents such a break of policy as there may be every third year.

Mr. FITZGERALD having replied,

The CHAIRMAN (after conferring with the other Members of the Committee): Although the amendment is attractive from many points of view, we think, with a general register, it will scarcely work; the balance of power could not be kept so well. We therefore adhere to the Board of Trade plan.

The Committee then adjourned.

WATH AND BOLTON GAS BOARD.

On Tuesday, the Committee of the House of Commons which deals with Unopposed Bills held a sitting for the purpose of considering the Wath and Bolton Gas Bill. Mr. EMMOTT presided.

Mr. BERRY, Parliamentary Agent, said the object of the Bill was to incorporate a Gas Board, consisting of representatives of the Urban District Councils of Wath-upon-Dearne and Bolton-upon-Dearne, in the West Riding, and to transfer to the Board, and enable them to carry on, the undertaking now being conducted by the Wath-upon-Dearne and District Gas Company. Under an agreement of January last, the concern was to be sold to the Wath Council. After the deposit of the Bill, however, it was arranged that a Joint Board should be formed of that Council and of the adjoining Council of Bolton—a great portion of the limits of supply of the Company being within the area of the latter Council. Provision was accordingly made, when the Bill was in the House of Lords, for the constitution of a Joint Board. The Local Government Board had presented a report with reference to the Bill; and the whole of the suggestions made therein had been given effect to. The maximum price for gas was 4s. per 1000 cubic feet. There was no sliding-scale. They were asking for a period of forty years in which to repay the money with which they would acquire the works, which were originally constructed in 1869. The period had been the subject of considerable discussion with the Lord Chairman of Committees in the other House. The Lord Chairman met the representatives of the Local Government Board, and after discussion with them agreed to the period of forty years, subject to a special recital in the Bill that, since the year 1902, £19,600 had been expended by the Company on new works and in renewals and for maintaining the undertaking in an efficient state. The Lord Chairman had required the production of a large number of figures showing the whole of the expenditure, and went very carefully into the matter. Part of the arrangement with the Local Government Board with regard to the period was a variation of clause 58, to provide that, for the extension and improvement of the gas-works, the promoters should not have any fixed amount of capital, but only such amount as the Local Government Board might sanction.

The CHAIRMAN: £70,000 is the sum that is being paid?

Mr. BERRY: Yes.

The CHAIRMAN: Of that you have spent nearly £20,000 recently?

Mr. BERRY: £24,000.

The CHAIRMAN: That is why you ask forty years?

Mr. BERRY: Yes.

The CHAIRMAN: Have you any precedents?

Mr. BERRY: There are two precedents—Pontefract and Appleby.

After further conversation,

The CHAIRMAN said: We will give you forty years in this case, on account of the recent expenditure.

Formal proof of the preamble having been tendered by the Clerks of the two Urban District Councils concerned, the Bill was allowed to proceed.

Reduction in Price at Northampton.—The Northampton Gas Company announce a reduction of 1d. per 1000 cubic feet in the price of gas.

Pontypridd Gas-Works Results.—The balance-sheet of the Pontypridd Gas-Works, prepared by the Accountant (Mr. L. R. Williams), shows a gross profit on the past year's working of £5755, equivalent to 5·39 per cent. on the capital at the commencement of the year. The income increased during the twelve months to the extent of £1673, and the expenditure by £1365. The balance in the sinking fund at the end of the year was £15,804; and the reserve fund stood at its maximum of £3000. After the payment of the various charges on loans, interest, and sinking fund, the net surplus for the year was £927, or £300 less than last year; this decrease being accounted for by heavier loan charges, which represented a difference of £600.

Breaking Contract of Service with a Gas Company.—At the Enniskillen Petty Sessions, on Monday of last week, William Fitzpatrick was charged by the Enniskillen Gas Company with having wilfully broken a contract of service with them. Mr. Thomas Hands, the Engineer and Manager, said that he found the gas-works in a most dangerous state at 11.30 on the night of the 13th inst., owing to defendant's neglect of duty. The boiler was short of water; and in another half-hour the centre flue would have been overheated. Nothing could then have saved the boiler from exploding, and dislocating the whole works, as well as jeopardizing property and life in the neighbourhood. He ordered defendant to go home. Defendant came back the next morning and demanded his money. He went into the office, and witness ordered him out. The police had to take him away. Defendant was fined £2, or, in default, one month's imprisonment. For using threatening language to Mr. Hands, defendant was ordered to enter into his own recognizances to keep the peace.

Clerical Staff of the Metropolitan Water Board.—In the House of Commons last Thursday, Mr. Carlile asked the President of the Local Government Board whether the Metropolitan Water Board had now 100 clerks more than were formerly employed by all the Water Companies whose undertakings were acquired, and whether the Board proposed shortly to make a call upon the rates for a contribution, whereas the Water Companies, under the same conditions, were able to pay their proprietors good dividends. Mr. Burns replied that the facts were as stated in the first part of the question. The increase in the number of officers of the Board was said to be due partly to extra clerical work, partly to the constitution of a department for the examination of water, as required by the Metropolis Water Act, 1902, and partly to the fact that the staff of the Board now perform the legal and surveying work for which the Companies employed outside firms. He understood, however, that the total annual amount of the salaries at present paid by the Board was about £5000 less than that paid by the Companies. With regard to the second part of the question, he had not been informed as to whether the Board proposed to make a call upon the rates.

MISCELLANEOUS NEWS.

EDINBURGH AND LEITH GAS COMMISSIONERS' PROVISIONAL ORDER.

A Question of Illuminating Power.

In Edinburgh, last Thursday, Friday, and Saturday, under the Private Legislation Procedure (Scotland) Act, 1899, an inquiry was held with regard to the Provisional Order promoted by the Edinburgh and Leith Gas Commissioners. Viscount FALKLAND presided; and the other members of the tribunal were the EARL OF STRATHMORE, Mr. JOHN M'CALLUM, M.P., and Mr. J. D. HOPE, M.P.

The purpose of the Order was to authorize the Gas Commissioners to raise further money for their gas undertaking; to extend the period for the construction and completion of their works at Granton; to establish a superannuation fund; and to confer further powers. It was provided in the Order that the prescribed illuminating power of the gas supplied should not be less than 14 candles; the quality of the gas to be ascertained by test, made at the official testing-places to be provided by the Commissioners at the City Chambers, Edinburgh, and at the Municipal Buildings, Leith—the test to be by the "Metropolitan" argand No. 2 burner.

There was no opposition to the Order, except by the Corporation of Edinburgh, upon the subject of the illuminating power of the gas. The Corporation stated, in their petition, that the illuminating power, in terms of the Commissioners' Gas Act of 1888, should not be less than 20 candles; and they objected to the proposed reduction to 14 candles. They also objected to the official testing place or places being dependent upon the Commissioners supplying or not supplying gas of the minimum illuminating power. They submitted that an official testing place or places should be appointed at the works of the Commissioners, and at the City Chambers, Edinburgh, or such other places as the Town Council might approve of.

The DEAN OF FACULTY, K.C., describing the scope of the Order, said that a great many changes had taken place since 1888. The use of the incandescent burner had been largely popularized among the working classes. In asking authority to reduce the minimum, the Commissioners believed that they would be giving to the consumers, whose interests alone they had to consider, an article which would be more satisfactory and more economical. They asked merely for a permissive power. From 1903 to 1907, some 70 Gas Acts had been passed; and of these 61 authorized 14-candle power gas. The Corporation of Leith, who had identical interests, did not oppose the Order; and Edinburgh's opposition was peculiar and half-hearted. In the Town Council, 22 voted for opposing and 22 against opposing; and the Lord Provost refused to use his casting-vote. The opposition was based, to a large extent, upon a misunderstanding of the real situation; and it was advantageous that the reasons at the bottom of the proposed change should be well ventilated. If it were the case that the proper and efficient and economical way of using gas as an illuminant was to consume it in the incandescent burner, it was surely extremely hard that the mass of the consumers in Edinburgh should get a less efficient and more expensive article supplied to them just because certain people insisted on burning the gas in a manner for which it was not properly adapted.

Mr. *W. R. Herring*, M.Inst.C.E., Chief Engineer to the Gas Commissioners, examined by the DEAN OF FACULTY, said that under the Statute the Commissioners had no power to make a profit, so that the interests of the Commissioners were absolutely identical with those of the consumers. The primary purpose of the Order was to raise money for the extinction of the annuities granted to the shareholders of the old Gas Companies, when the gas undertakings were acquired by the Commissioners. This would be a great financial advantage, and would enable them to reduce the cost of gas to the consumers. The extension of time asked for related to certain subsidiary works. When they purchased land for the construction of their new works, they naturally bought more than they required. The time was not ripe for carrying out these works. The establishment of the superannuation fund would bring them into line with other similar undertakings. The superannuation scheme was founded on parallel lines with that of the Edinburgh Corporation, as in the event of Edinburgh and Leith amalgamating, the Gas Commission would become merely a department of the Edinburgh Corporation. The Commissioners for some years had been giving special attention to the question of the standard of gas which they ought to supply. He had been consulted frequently on the matter, and had carried out a great many experiments. In conducting these experiments, he had used all kinds of coal. The result of his deliberations and experiments was that the Commissioners considered it was in the interests of the consumers that the prescribed number of candles should be as proposed in the Order. The principal difficulty they suffered from in Edinburgh was that all the gas appliances made to-day were made for the standard of gas supplied in England and Germany. These came on the market in Edinburgh; and the consumers bought them. The proportion of air required to burn the Edinburgh gas was very much greater than was necessary for lower grade gases for which these appliances had all been designed. They could not suggest that appliances should be designed to suit Edinburgh gas, which had to be consumed as best it could; and the result was that the consumer lost efficiency, and suffered inconvenience. He paid for expensive enrichment which did him no good. Although the statutory minimum from 1888 onwards had been 20 candles, for many years gas of higher illuminating power was supplied—viz., 24 to 26 candle power. The common complaint about too rich gas was that it blackened the incandescent mantles, which destroyed the light, and eventually the mantles too. The consumer obtained less light, and paid more for it. In the passage of the gas from the new works at Granton, they lost in 3½ miles somewhere about 2½ candles in the severest weather. If they supplied a high-grade gas, such as 20-candle power, there was bound to be some loss, more particularly in cold weather—although loss occurred even in midsummer. The hydrocarbons condensed into a liquid; and the gas the consumer obtained was not the rich gas which was manufactured, while they had to remove from the mains a liquid which was useless. This was one of the wasteful results of supplying a high-grade gas. When the consumer got it, the high-grade gas was not so useful for the majority of the purposes for which gas was wanted. It was, moreover, possible to supply a lower grade gas at a much more uniform quality than a high-grade gas. There was less in it of the particular element which was subject to atmospheric influences. It was a material advantage to get gas uniform in quality. They required a great deal more air with a high-grade gas to ensure combustion. The universal practice of recent years was to abandon the system of artificial enrichment, on the ground that it was useless and wasteful. The price of the special cannel coal from which that artificial enrichment was obtained, had been going up; while the quantity available had been constantly decreasing. If the 20-candle power standard was maintained, they would have to face a serious increase in the price of gas; whereas if a low-grade gas was supplied, there would be an immediate and important economy. He estimated that they would save £25,000 this year if they used common coal alone for the manufacture of gas, as against the present mixture of common and cannel coal. This would lead to a considerable reduction in the price of gas. If the Order had not been opposed, and he had had reasonable assurance that what they asked for would be granted, he would have prepared his estimates on the basis of recommending a reduction of at least 2d. in the price of gas. For lighting purposes, the lower grade gas was equally efficient with the higher grade; for stoves and heaters, it was, for practical purposes, the same; and so far as power purposes were concerned, the low-grade gas was better. Consumers could get a good incandescent mantle and glass chimney for 7½d. With a good incandescent burning apparatus, they secured from seven to ten times more light than by consuming the gas with the best flat-flame burner. They also used less gas. The ordinary flat-flame burner took 4 cubic feet of gas; and the incandescent burner gave its best efficiency with 3½ cubic feet of gas per hour. Incandescent lighting was being adopted extensively by the artisan class. He had experimented with 14 and 16 candle power gas. Fourteen-candle gas, in an incandescent burner, gave 29·94 candles per cubic foot. In order to compare 14-candle power with 29·94, they ought to multiply the latter figure by 5, which gave 149·7. They increased the 14 to about 150, which was more than ten times. His experiments were made with 25 different qualities of coal. He made similar experiments with 16-candle power gas; and the difference from 14-candle power was the difference as 29·94 was to 28·65. This was somewhat less satisfactory. The 14-candle power gave rather a better result. These experiments had made it quite clear that, so far as the users of the incandescent light were concerned, it was rather a disadvantage to raise candle power above 14. In January, 1907, he took a census of consumers using incandescent burners in Edinburgh; and the number was 65 per cent. over the whole of the districts. In some working-class districts, they got 91 per cent. The artisan class was taking to the incandescent burner even more than the middle class. He had prepared an estimate of the percentage of the gas consumed by users of the flat-flame burner; but it was difficult to ascertain for what purpose a man used the gas he received. They knew the number of cooking-stoves, gas-fires, gas-engines, and so on; but they had no data as to the number of laundry-irons, boiling-stoves, small grills, &c. The approximation he had arrived at was 15·89. It was not so much upon the illuminating quality of the gas that its satisfactory result depended, as upon the intelligent consumption of it with a suitable burner. It depended entirely upon the user. If the Edinburgh Corporation introduced incandescent burners with low-grade gas for the lighting of its common-stairs, after allowing for equipment and annual maintenance, they would save £2076 the first year, and get 20 candles illumination instead of 2½ from each burner. The saving after that would be £3630 per annum. They would use 33 per cent. less gas, and get a better light. He was prepared to recommend his Commissioners to undertake the lighting at 10 per cent. less than it was now costing the Corporation. The private consumer who had a preference for the flat-flame burner could improve the efficiency of his burner by fitting on a little cap which he showed. The result was that the old burner just became part of the pipe conveying the gas; and rather less gas than before was used. If the desired powers were granted, he would recommend a house-to-house visitation for the purpose of inserting these caps, which would give a better light than was now obtained from the 20-candle power gas. He did not know of a single individual who would suffer any loss by the change. On the other hand, they would all get some gain. Assuming for a minute that some consumers would suffer an inconvenience, the Commissioners must try to satisfy the majority, and endeavour to win over the minority to what they were prepared to recommend in perfect good faith. Even though there were some foundation in fact for the suggestion of prejudice, which he did not think there was, he did not consider this ought to determine the decision of Parliament in the matter. As a result of the investigations made by the Departmental Committee of the Board of Trade, appointed in January, 1904, the minimum candle power was fixed at 14; and in so far as any changes had been made as to the supply of gas to the consumer, the Model Clauses in the Gas-Works Clauses Act had been adopted in the Commissioners' Order. Of the 70 Gas Bills passed since that Act came into force, 14-candle power was the minimum taken in no fewer than 61. In practically all of these 70 cases the testing-place was the works or within 200 yards thereof. In most of the large corporations, both in England and Scotland, the minimum was very much less than 20 candles. The practice in Scotland had been to have a somewhat richer gas than in England; but the results attained had been very much worse. As to whether there was any material advantage to the consumer as between 14 and 16 candle power, the consumer could not possibly detect it with the ordinary appliances. The promoters were applying for powers which they hoped would cover their requirements for the next ten years. They were asking for the minimum, not that they might immediately come to it, but that they might gradually approach it when they found it convenient to the consumer. The policy of the Gas Commissioners in fixing the standard of gas from year to year would be regulated by

what they found was good for the community, and by the wishes of the community, whom they directly represented. He did not see any necessity at all for putting restrictions upon the Commissioners in this matter by keeping the candle power above 14. Any money saved in administering or in working the undertaking went to the direct benefit of the gas consumer, and to nobody else. In the ordinary practice of Parliament, the gas was tested at the place of production or nearby. In the majority of cases, the testing-place was at the gas-works. In the Commissioners' own Act of 1888, this was provided for. In the petition against the Order, it was suggested that the official testing-place ought to be at the City Chambers, or at such other place as may be approved by the Corporation. This was taking away from the Commissioners statutory powers they already possessed. So long as they supplied gas above 14-candle power, the statutory power was of some monetary value to their customers; and he did not think the Commissioners were justified in sacrificing the power they now had merely to meet the views of the Corporation on the matter. Further, the proper place to control the quality of the gas was the gas-works. There was nothing peculiar in the circumstances of Edinburgh to make it require a higher candle power than any other towns; and there was nothing special in the situation of the city which would entitle it to demand that there should be a different test-burner. All the members of the Gas Commission elected by the Corporation of Leith were in favour of the Order. There was no opposition or objection from the county, and only three of the sixteen members of the Commission elected by the Corporation of Edinburgh objected to the proposed reduction of candle power.

Mr. M'CALLUM: I suppose you like to work with a variety of coal?

Witness: We are obliged to do it.

Would you work with common coal if you got the minimum?—That is our wish. It will open up a very much larger field to our service. Consequently we should be able to buy coal more cheaply.

Do I understand that your bye-products would be more valuable from common coal?—We should get a greater weight of coke, and I anticipate better results from the other bye-products.

Could you not give us a nearer approximation of the amount of gas consumed, not for lighting purposes, but for heating and power?—The figures I have given with regard to gas used for power, and in cooking stoves and fires, I think you may take as being correct.

I should have thought you would have had a much larger percentage?—We have not; and I think one of the reasons is that it is quite a common thing for us to have complaints about stoves and fires arising out of the rich gas we have been compelled to supply.

I think you are right as to the test, because you lose so much in transit; but if the test is to be entered into, you prefer a daily test to an average monthly one?—That is so.

I think you are right there, too. I suppose you wish to test on scientific lines?—Undoubtedly.

And the other is more by rule-of-thumb?—We are being hampered.

Cross-examined by Mr. F. T. COOPER, K.C., for the Corporation of Edinburgh: From the point of view of the consumer, 14-candle power gas could be made as good as the 20-candle gas the Commissioners are bound to make at present, if used in the modern way; and, in my opinion, it ought to be so used.

Mr. COOPER: If that is so, why did you tell us that the Commissioners had not the slightest intention of bringing the gas in the immediate future down to the standard which you say is proper and good?

Witness: A process of education in the proper appliances must take place. To drop immediately to 14 candles would inconvenience some of our consumers.

You propose in the Order to alter the test from the union jet to the argand burner?—We have merely embodied the Model Clause.

Cross-examination continued: If the consumers wished to put themselves as nearly as possible in the position of those at the testing-station, they would have to buy a burner which would cost them a shilling, as compared with one that at present cost them a farthing—that was to say, if they persisted in using the flat flame. The position might be put thus—that although, nominally, the promoters only proposed to reduce the candle power from 20 to 14, they were really proposing to reduce it from 20 union jet to something considerably over 14 union jet. The question of reducing the candle power had been before the Commissioners since 1900. He believed it was Bailie Douglas who first raised it; and he (witness) reported against it then, as he considered the time was not opportune. The public were not educated up to the new methods of using gas, nor was the apparatus as perfect as it was now. In 1905, the candle power of the gas supplied was reduced without any inquiry as to how many people were in a position to use the lower grade gas with advantage. He satisfied himself at that date that they would not notice the difference; neither did they. He pinned his faith in the lower grade gas on the use of the incandescent burner, primarily, for lighting. He had no doubt that it would be better for the consumer to get a lower grade gas. He based this opinion partly upon the difficulty of getting cannel coal. Scotland was the country where cannel was produced in the largest quantities; and it was exported from this very neighbourhood to practically every part of the world. This was what he complained of. It was why it was so dear for him. Coal had risen in price. It might have fallen since 1892. The cost of cannel coal at the pit-head this year would be about 19s. 6d. per ton. It was because of the increased price of cannel that he found a financial difficulty in manufacturing the richer gas.

Mr. COOPER: Is it not the case that in 1892, when you were manufacturing gas of 25-candle power, the price of cannel coal at the pit-head was 26s. 6d. per ton?

Witness: I was not in Edinburgh at that time.

Will you tell me what has been the fluctuation in cannel coal in your experience in this district?—24s. or 25s. was the highest price since I came to Edinburgh, and 16s. or 17s. the lowest.

May I take it that, if the necessity for a lower candle power gas depends upon the fact that cannel coal is so dear, it is not so dear now as in past times when you were giving a richer gas?—That is probably a fact; but we do not base our case on the cost of cannel coal.

Cross-examination resumed: In order to arrive at the computation that 65 per cent. of the consumers used incandescent lights, all houses and premises to which light was supplied were visited. Wherever an incandescent light was used, the place was marked down as one in which gas was used incandescently. It was an erroneous opinion that the incandescent mantle would not stand any vibration. The North British Rubber Company's works, in which heavy machinery was used, were entirely fitted up with incandescent burners. It required a special adjustment where there was vibration. They recommended an anti-vibrator, costing 4d. This had to be added to the cost of each light; but there was economy with it. He had considered the matter of common-stair lighting, and had fitted up several burners suitable for the purpose. These were satisfactory, except that there was difficulty in getting a sufficient air supply for the burner; and this necessitated frequent cleaning. There was no reason in the world why the stair-lights in Edinburgh should not be converted; and he was prepared to advise his Commissioners to undertake to do it. He was aware that one of the difficulties was that when people swept their stairs they swept the dust into the mantles; and this was why they advised a special burner. It smoked a little with their high-grade gas. As to the general question, the working class was most to be considered; and they had considered this class the most. The consumer would save at the least 33 per cent. of his gas bill; and this would go a long way towards paying the cost of installing incandescent burners. At the end of the year, he would be in pocket by the conversion. An artisan's house, with room and kitchen, would require two incandescent burners, at a cost of 1s. 3d. There was no reason why these should not last ten or fifteen years. It was not the case that in the poorer class of houses incandescent mantles could not be used because of the treatment they suffered from the inhabitants. The incandescent burner was used more by the artisan than by the person of higher rank. It was to some extent a fact that the pipes in the older houses in Edinburgh had been made of small size, having in view the rich quality of gas supplied. If gas of inferior quality were furnished, and the owner, from any reason, could not, or would not, use incandescent burners, the pipes would have to be increased in size in a few isolated cases. If gas of 14-candle power were supplied at the works, it would reach the consumer of the quality of 14-candle power. They could guarantee this. It was his experience that the consumer to-day did not get out of the gas the best by one-half that he could get if he used good burners; and the Commissioners were willing to undertake a house-to-house visitation to see that everybody's burners were good, so that the small minority would get more light than now, and the large majority, as well as the small minority, would have the advantage of cheaper gas. Recently they had erected large gas-works at Granton, costing £750,000. The capital charges upon this would, he believed, amount to about 3d. or 3½d. per 1000 cubic feet, over and above what was formerly the case. They did not contemplate still further considerable capital expenditure, except in connection with the purchase of annuities. The construction of the new works had resulted in such economies in working that they had been able to meet out of revenue all capital charges, and had reduced the price of gas by 3d. per 1000 cubic feet. The price had gone up since then, owing to the increase in the price of coal. In winter time they used about 30 per cent. of cannel; but in summer they sometimes reduced it to about 20 per cent. He did not say that by lowering the quality of gas consumers would save one-third of their bills. What he did say was that if incandescent burners were introduced, the consumption would be reduced by one-third. The people who used incandescent burners already had the advantage of lower consumption; but all consumers would receive the benefit of the uniform reduction which would take place. He did not say that 50 per cent. of the gas consumed was by incandescent burners, and the other 50 per cent. by flat-flame burners. What he said was that, in his opinion, at least 85 per cent. of the gas they sent out at present was used otherwise than in flat-flame burners. Power users would get an advantage by lower quality gas. The gas-engine did not depend solely on the calorific power of the gas; it depended to some extent upon the composition of the gas chemically. Only one class of gas-engine that he knew of was made for town's gas supply. He said it did not matter to a gas-engine whether the gas is made of high or low calorific power. The calorific power of 20-candle gas in Edinburgh had been expressed by Mr. Simmance, in his report to the Corporation of Edinburgh, at 753 B.Th.U. If they got the authority they asked, the calorific power would be from 560 to 580 B.Th.U.; but the powers they asked were permissive. He had not, however, proved what the calorific power would be, because he had not yet been allowed to supply such gas. If the gas bills of their consumers came down, it would probably affect the revenue of the Commissioners by about 10 per cent.

Mr. COOPER: Is it your opinion that the upright burner is out of date, and that its time is past?

Witness: I have expressed that opinion in technical meetings because I believe the inverted burner is better.

So that you are suggesting that the poor people in this town can get the benefit of cheaper gas by using an upright burner which you think is out of date?—I have nothing to do with persuading consumers what type of burners they are to use. If they took my opinion, there would be no contest. I still recommend the inverted burner as being, all round, the best.

But if the inverted burner is to be used, the cost of the change to the consumer will be double what you suggested yesterday when you put forward the upright burner?—That is quite likely.

Until quite recently, the Scotch standard had been greater than in England; but there had been lately notable instances in which it had been reduced in Scotland. In Glasgow, they had 16-candle power, and in Dundee and Airdrie 15.

If 16 candles is low enough for Glasgow, why should you want to go down to 14?—In my opinion 14 is quite as good as 16, for all practical purposes; and we have adopted the Model Clause.

You are asking permission to go as low as anybody else has ever gone?—We are asking 14; some have gone as low as 12 candles.

Is it not the reason why Scotch towns have got a higher candle power that they are much nearer the coalfields?—No. Aberdeen is not half as near as many English towns.

Cross-examination continued; When the 1888 Act was obtained, the

two gas-works were then in the centre of Edinburgh and Leith. The gas from these works would then be sent about 2 miles. From Granton to the City Chambers was 4½ miles, by the pipe-line. To the extremity of Portobello, the distance would probably be 7 or 8 miles. They knew that in a travel of 2 miles higher grade gas would vary to the extent of several candles; but there was no loss in the transmission of low-grade gas, so far as his experience went. He had 5½ years' experience as assistant at Hastings, where 14-candle gas was transmitted 5 miles without loss. He had no experience of what the loss would be in the transmission of 14-candle gas for 7 or 8 miles. The gas at Hastings was 14 candles tested with an argand burner.

Mr. COOPER: If the Commissioners wish to do honestly by the consumers, why do they object to the gas being tested about 4 miles away, at the City Chambers?

Witness: The question of controversy enters into that. We are conscious of the fact that we cannot deliver the gas we now make all over our district up to the standard quality prescribed by the Act. If it were tested in town, it would vary considerably. There would be times when it would be even more in town than at the works, owing to changes of temperature. That would give us, at our testing-station in town, a constantly changing and varying quality of gas. This would be reported to the public. It would be taken advantage of by those who wish to criticize the undertaking; and it does us harm commercially by its being suggested that we are not living up to our obligations.

If that be the experience at the testing-places, it must be the experience of consumers in the City?—I quite admit that.

Does your objection to the City Chambers arise from your fear that the citizens will then know that there are fluctuations in your gas?—No. In the first place, I do not care that my Commissioners should sacrifice a statutory right which they already possess. Secondly, it is of no service to the consumers to know that they are getting all sorts and qualities of gas, varying with the changes in the weather.

Is not the object of testing gas to let the consumer know the quality he is getting?—My object in testing gas is to enable me to make a uniform quality. The public object, no doubt, is to inform them that they are getting what they are supposed to get.

When you are testing at the gas-works, there may be the greatest amount of fluctuation in the sort of gas you are supplying to the citizens?—Not when testing at the gas-works.

So far as it is less, you are not supplying the citizens with what you are bound to supply them with?—Oh, yes.

It is quite possible that the citizens are at the present time consuming gas which, if examined in their houses, would be less than 20 candles?—That is quite possible. I cannot say how much less, but probably from 3 to 1½ candles.

When the gas is tested at the gas-works, has notice to be given to you beforehand that the official is coming?

Witness: I believe under the old Act of Parliament the official tester is required to give us 24 hours' notice. This seemed to me such an absurdity, that in 1904 I put myself into communication with the official tester, and also with the Town Clerk, and suggested that the examiner could come whenever he liked. I suggested also that he should be required to average his tests from time to time. I had no response to the suggestions; but, as a matter of fact, I put them into force, and from that time to this, the only intimation we have had has been a telephone message from the examiner that he is leaving the office to test the gas. He arrives about a quarter of an hour afterwards. I have been told that the city have fitted up a testing-station in the City Chambers.

Did you intimate recently that you would cut off the gas from this station?—Yes. Because I wanted to preserve the position of my Commissioners before this tribunal. I did not wish Counsel for the Corporation to come forward and say we were consenting parties to a supply of gas to their photometer.

Why should you cut off the supply of gas from the testing-station if you had nothing to fear from it?—It was only to prevent my Commissioners being put into a false position before this tribunal. I acted without legal advice. We were asked some time ago to give a supply to a meter-testing station. We gave them a supply at high-pressure; and it was only informally that I heard that they were fitting up a photometer. It was a matter for adjustment whether there should be a photometer in the City Chambers or not; and I wrote that I could not allow the gas to be used for the photometer or testing apparatus, and that, if they were using it, I should have to shut off the supply. I did not, in fact, interfere with the supply.

What have you to fear from a testing-station being established at the City Chambers, which will show that the guaranteed quality will be obtained?—I believe we have suggested that in our own clauses. I fear nothing.

Why do not you concede it?—Because it is contrary to gas-works practice.

Is it not the case that testing-stations for gas are scattered all over London?—Yes; but the conditions of gas supply in London differ from those in small towns, comparatively, like Edinburgh.

Why should not we have in Edinburgh what the London County Council have—a testing-place at our Chambers?—In the first place, the London area is supplied with gas from more than one works, so that the quality may vary in its way from a particular locality.

What is the cost of each individual light you would put into stairs?—My estimate is based on 2s. 6d. each.

Have you not charged the Corporation 6s. 6d. each?—We were asked by the Lighting Department to make a special burner to suit the requirements; and when you make a dozen or so, you necessarily incur much more expense than if you order (say) 10,000. I am quite sure we should be able to get them made in bulk for 2s. 6d.

Re-examined: Members of the Gas Commission had more experience in gas matters than town councillors who were not on the Gas Commission. As far as he knew, only themselves and the Dublin Gas Company were now required to test by the flat-flame burner. It was quite contrary to current practice that this test should be repeated.

Witness illustrated by demonstrations on a stand containing burners taken from consumers' houses, the effect of placing the cap he had referred to over the lighted burner, and also the light given by an upright "C" incandescent burner. He explained that they got from seven to ten times the illumination from the incandescent burner that they did from any of the others. Five or six years ago, there was undoubtedly a deficiency in the supply of gas in the city, and particularly in the area north of Princes Street. This was due to the distribution system; and when he told them that since 1899 the Commissioners had expended £120,000 in putting in larger main pipes in the streets, in order to supply these districts, they would see that they were meeting the point. It was then really a question of small pipes in the houses. This remained a fact to-day; but as they had no power, and could not persuade their customers to enlarge their pipes, they had to supplement the supply outside the houses, and thus ensure the small pipes carrying the supply which was required. There was no difficulty in giving a largely increased supply, even for cooking and heating purposes, through the small pipes. If a larger quantity of low-grade gas was to be burned, the consumers would have no difficulty in getting it into their houses. If they increased the illuminating power of the gas, they increased the theoretical calorific power; but the ratio was a very much lower one. Accordingly, it was just a question of expediency whether it was, or was not, worth while to sacrifice a few units of calorific power, in order to get a gas which was otherwise suitable. While it was true that they did sacrifice, in theory, a certain number of units of calorific power, practically this would not affect the efficiency of the gas to the consumer. It would never be discerned by an ordinary consumer. It was not possible to supply gas of absolutely uniform quality in the house of every consumer in the city, so long as they had anything above 14 candles. He was prepared to guarantee 14 candles. If they found that the people were not getting 14 candles, the Commissioners would make a higher quality at Granton. It was quite impossible to supply gas of uniform candle power all over the city. The bulk of the citizens of Edinburgh got their gas direct from the high-pressure main which came straight from Granton. With 20-candle gas there would be a loss, in the case of gas which was stored in holders in the town. What was put into them one day might not be distributed till the next, so those who were supplied from the holders would be liable to a greater loss than those who were supplied direct from the main. He did not agree that the City Chambers was a suitable place for the testing of gas. There were other spots which would be better. But if the standard were reduced to 14 candles, he was quite willing to have the gas tested at the City Chambers, or anywhere else the Corporation might choose.

Mr. M'CALLUM: Notwithstanding the advance of the electric light, gas companies are mostly increasing their consumption?

Witness: Yes; but not so much as before. Owing to the introduction of the incandescent burner, less gas is required; but they are so content with the results that they are satisfied that the increase should not be so great as it used to be.

Professor *Vivian B. Lewes* said that at one time Edinburgh was supplied with gas of 25-candle power. He considered this was neither judicious nor beneficial. At that period, Edinburgh used to suffer from the reproach of being the city supplied with gas of the highest quality, and the worst lighted city in the world. This had been removed now; and the city was one of the best lighted. Mr. Herring was quite right in advising his Commissioners to come down to the statutory 20-candle power. He considered it a judicious thing to do to reduce it to 14 candles. The Commissioners were asking powers which Parliament endorsed to all English corporations. In all the recent cases legislation had been in the direction of reducing the candle power, on account of high power not being necessary, owing to the advance of the incandescent mantle as a lighting agent, and the introduction of the "Metropolitan" argand No. 2 burner. As the result of research, it was made perfectly clear that for each gas of a particular illuminating power they must have a burner which would supply the right amount of air for the consumption of the gas. If they took, as had been done up to that period, a burner which was fitted for burning 16-candle gas—as the "London" argand burner was—and tested with it a gas of some lower quality (say, 14 candles), the air supply was so much in excess of what was needed by this quality of gas, that they were really consuming it in something which was approaching the atmospheric bunsen burner. A great deal of the luminosity was destroyed. The old union jet flat-flame burner was so brutal a method of treating gas, that no one with any scientific ideas at all on the subject would ever dream of employing it. They were there taking in a quantity of air which rendered the giving of a proper illuminating power by the gas an impossibility. With a gas of 14-candle power, there were so many points strongly in its favour that one was able to say, without hesitation, that it was a better supply than that of 20 candles. They had been dwelling upon the question of carrying power—that was to say, the duration of the gas in the mains. High-power gas was largely dependent upon temperature and other conditions. If, on the other hand, they got down to 14 candles, the easily condensable gases were not there, or were in very minute proportions; and the result was that it would stand changes of temperature, or travel through the mains without any loss of illuminating power. It was of importance to have gas of a candle power which would be guaranteed over a distance; and this was possible with 14-candle gas. Any big changes in the gas caused such variations in the consumers' mantles that high-grade gas was really a distinct drawback. He considered a 14-candle gas a thoroughly satisfactory article. He himself should not object to having no candle power at all; but 14 candles for incandescent lighting was better than 20 candles, because with the latter there might be a slight shortage of air supply to the mantle, and some of the gas would then not be consumed. There would be a blackening of the mantle; and in a short time it would be destroyed. With a 14-candle gas, the amount of air required was far less; and it was found that the burner could supply it perfectly well, at ordinary pressure, with the result that they did not have the blackening. They obtained, when measured on the photometer, generally a better light with 14-candle than with 20-candle gas. Theoretically, if they lowered the illuminating power from 20 to 14 candles, they, to some extent, lowered the calorific value of the gas. But there, again, the same fallacy crept in as with the incandescent mantle. If he were to take a "C" mantle into his laboratory, and regulate it exactly, he could get more light

from 20 than from 14 candle gas. The same with heating. If they took a 20-candle gas with 700 B.Th.U., and a 14-candle gas with 560 B.Th.U., the latter had a considerably less heating element—that was, the total amount of heat which could be got from these gases, burned in the most perfect way, in the most perfect instrument for abstracting the heat. With 20-candle gas, burned in a stove, a cubic foot ought, practically, to give 700 B.Th.U.; but they would find that, perhaps, 200 B.Th.U. were lost by radiation, 100 B.Th.U. were lost in the process of combustion and went up the chimney, and only a small fraction went to absolute heating. This small fraction would be obtained with a 14-candle gas. But then came in the question of complete combustion. In an enclosed cooker, it was far more difficult to get the requisite quantity of air for complete combustion with a 20-candle than with a 14-candle gas. He had not the slightest doubt that, if one went into a kitchen in Edinburgh, where they were using a 20-candle gas, there would be detected a disagreeable, fœtid smell, which was due to unconsumed products of combustion. Many ladies said they could not use gas-cookers, which was due to the escape of products of combustion. So that, though it was scientifically accurate to say that there was a higher calorific value in high-grade gas, when they came to use the gases practically the difference entirely disappeared. He always preferred the lower grade. The better way of getting illumination from gas was by using the incandescent burner. In Germany it was impossible now to find a flat-flame burner. If consumers gave a little intelligent attention to the flat-flame burners they used, they would not really suffer any injury, in the way of light, by the substitution of 14-candle gas. If burners suited to 14-candle gas were fitted, everybody in Edinburgh would rejoice at the change. At the present moment, wherever they had an inlet for gas to the City of London, they had a testing-station, which gave the quality of the gas supplied to the district. He was aware that a large portion of Edinburgh was supplied direct from the main; and he saw no ground whatever for the suggestions that the rule of the Act of 1888, as to testing at the works, should be altered. The offer in the Order to supply 14-candle gas if the testing-station were at the City Chambers was a very fair concession.

Cross-examined: The merit of the No. 2 burner was that they got with it the maximum luminosity out of the gas. It would bring out the full value of a 16-candle or even a 12-candle gas.

Mr. COOPER: Would it give any test of the gas as it goes into the consumers' houses?

Witness: No; nor does any other method of testing.

Is it not the case, however, that a union-jet burner comes very much nearer to giving a test of the gas as it goes into the consumers' houses than the argand burner does?—Good heavens, no. It gives a far less test. If you test with a union-jet burner and get 16 candles from the gas as it goes into the consumer's house, if he used an incandescent mantle he would get 140 candles.

Supposing you have a gas which shows 20 candles with an argand No. 2 burner, what would you expect the gas to show with a properly regulated union-jet burner?—In the first place, you could not, without reducing it below the statutory rate of flow, get a test at all, because you would have the thing tailing up high above the chimney. An argand No. 2 burner was not suitable for testing 20-candle gas. It could not be used with a gas above 16 candles. A 14-candle gas, tested by a union-jet burner, would give somewhere between 11 and 12 candles.

If you have a union-jet burner which shows 14 candles, what would it show with the ordinary flat-flame burner?—If they were both perfect burners, they would both give the same result.

Is not the position this, that if the Gas Commissioners are at present bound to supply 20-candle gas with a union jet, every consumer who chooses to put a union-jet burner on his fittings ought to get 20-candle power?—Yes; if they were identically the same burners, and if there were no loss in the travel from the works. If they were sufficiently brutal to try to burn a 14-candle gas in a union-jet burner, they would probably get something like 8 candles.

Assuming that a 20-candle power union jet is equivalent to 26-candle power argand, the proposal of the Order is to reduce the power from 26 to 8 candles?—You can get an even greater contrast than that, by burning the gas in a bunsen burner where you would get no light at all. The illuminating power of the gas suggested by you is so absolutely fallacious that it is really not worth discussing.

There would be a very big reduction in the illuminating power of the gas, which you hope to make up for by an improvement in the fittings—by the use of incandescent lights?—Yes.

Is it not the case that, with incandescent lighting, to get the best result out of it, it requires very much more careful treatment than union-jet burners?—Not if you have a uniform supply of gas. The trouble with the incandescent mantle is almost entirely due to variation in the quality of gas. The advantage of 14-candle power gas over 20-candle gas is that it is far more stable.

Is not that another way of saying there is no good stuff in 14-candle power to lose?—What you and all the supporters of high-power gas call "good stuff" I am afraid we now look upon as being the bad stuff which gives rise to all the trouble.

It makes the difference between 14 and 20 candle power?—It also gives the headaches, and the dirt, and half the trouble. Continuing, witness said it was the condensable, not the good stuff, that was out of the lower power gas. In cooking apparatus suited for 20-candle power gas, the burners would have to be regulated for a 14-candle power gas. Otherwise the burners would flash-back. Mr. Herring would send men round to slightly close the air-rings. As for requiring more gas to get the same heat, they would probably find no difference in practice. Theoretically, of course, they would have a difference in the direction of an increased consumption. Gas-engines made to suit the present calorific power could be adjusted to the new calorific power by reducing the air supply. They would require a slight increase of gas and a slight decrease of air.

Mr. *J. F. Simmance* said he was Official Examiner to the Manchester Corporation Gas Department, and to a number of gas companies. He most certainly approved of the proposal to reduce the candle power in Edinburgh from 20 to 14. He considered the reduction most judicious; and the change in the quality of the gas necessitated the change in the test-burner from the old union jet to the argand No. 2. He agreed with the former witnesses as to the advantages of the lower grade gas.

Cross-examined: There was no statutory maximum nor minimum in Manchester; and the candle power ranged round about 18. He did not know what gas showing 14-candle power in the argand burner would show in the union jet. It would be considerably less. He thought they should get 10 or 11 candles out of it. The cap produced in evidence was certainly better than a new burner. It was quite suitable to be put into the houses of the poorer and more careless class. He had seen a type of incandescent burner that struck him as being suitable for the lighting of common-stairs; but he should like to see one fitted up to judge just how it looked. He thought it would do very well.

Mr. *Corbet Woodall* stated that the introduction of the incandescent mantle had affected in a very radical manner the question of the lighting value of coal gas, as had also the adoption of gas for cooking, heating, and power purposes. These changes had made the mere luminosity of gas a secondary matter to its calorific value. His Continental experience showed that the incandescent burner could be used practically and conveniently even among the working and poorer classes. In Berlin and other towns, testing for illuminating value had been discontinued. This was because it was now recognized that the illuminating value of the gas had very little to do with its practical utility, either for lighting or other purposes. The proposed change in Edinburgh was just in conformity with recent parliamentary practice. He approved of the scheme in the Provisional Order.

Cross-examined: The calorific value of gas went up and down, though not directly with its candle power. The difficulty, however, in using the higher power gas was considerable; and the attention required was greater. On the Continent, the coal was very inferior for gas producing purposes; and in Berlin more than 50 per cent. of the coal came from England. It was all incandescent lighting in Berlin; and this was the most efficient way of burning gas.

Mr. *Alexander Wilson*, Gas Engineer to the Glasgow Corporation, said that during 18 years the illuminating power of the gas used in Glasgow had been repeatedly reduced. It was 23 candles in 1890, and was now nearly 16-candle power. In 1907, Glasgow received parliamentary authority to have their gas tested in accordance with the Model Clauses. It was an obvious convenience to adhere to the general standard, and meant a great deal to manufacturers of apparatus. Their reasons for gradually reducing the power in Glasgow were to supply the quality best suited to the requirements of the majority of their consumers; to enable them to produce a better quality of coke, and more of it; and to reduce the cost of gas supplied to the public. The gradual reduction in the candle power had had these beneficial effects. Formerly they had many complaints; latterly they practically had none at all. The complaints were due to the fact that it was more difficult to manage the admixture of the air in the case of the higher grade gas. In Glasgow, they had given their consumers greater satisfaction, and had economized considerably in the cost of manufacture. The gas was tested at the works. The area of supply was 98 square miles; and they had 260,000 consumers. In one case the gas was sent 12 miles. The proper place to test the gas was at the works, where it was manufactured; and that was especially so in the case of a corporation as distinguished from a company. The artisan class appreciated the value of incandescent lighting far more than the middle class. An incandescent burner more than paid for itself in the first year of its use. They introduced incandescent lighting into Glasgow common stairs; and the policy of the Lighting Committee was to go on with this. They did not find serious trouble in the up-keep, although the burners were installed in some of the worst localities. He had been in Berlin, and considered it the best lighted city he had seen. He had been informed that the quality of the gas there was 8 to 10 candles. Berlin showed that people apparently could live happily without the flat-flame burner.

Cross-examined: The public seemed to get quite as good results with the lower grade gas, with less trouble. In Glasgow, many people had returned to gas after using electric light.

Mr. *J. Somers*, Chief Superintendent of the Commissioners' Meter-Reading Department, gave evidence as to a census conducted in Edinburgh with a view to ascertaining to what extent incandescent lighting was in vogue. In one factory, 2700 incandescent burners were in use; and the Corporation employed in the streets about 10,000 burners. For the purposes of the census, these were regarded merely as two individual consumers. The result showed that 65 per cent. of the individual consumers in January last were using incandescent lighting. The number of gas-fires was 5385; of cooking-stoves, 8234; and of gas-engines, 426. Altogether it was estimated that about 85 per cent. of the gas used was employed for purposes other than luminous flame lighting.

Councillor *J. T. R. Wilson*, Convener of the Edinburgh Town Council Public Lighting Committee, and a member of the Gas Commission, gave details of the conversion of the street lighting from flat-flame burners to incandescent. Formerly they got only 6 or 7 candle power from the street-lamps; while now they obtained over 60 candles. There was difficulty at first, owing to the trouble consequent on the richness of the gas. It was troublesome to regulate the air supply. Eventually they got a special mantle; and there was now nothing to complain about. The Gas Commission asked the Committee's permission to carry out certain experiments in introducing incandescent lighting to common-stairs. It was only within the last three months that a satisfactory burner for this purpose had been evolved; and if they had a lower grade gas, the burner would be very satisfactory. This would do away with the blackening of the mantles. If the Commissioners supplied a lower grade gas, he would be prepared to recommend his Committee to light the whole of the stairs with incandescent burners. This would give a much better light, and effect a considerable saving. He believed it would be advantageous to the consumers if the Commissioners secured the powers they sought.

Cross-examined: He had no practical experience of making gas or carrying on a gas business. The conversion of the street-lamps cost nearly £2 per lamp; and the annual cost had slightly increased. There was never a motion in the Town Council to reduce the candle power to 14.

This concluded the evidence for the promoters; and the case for the opposition was then opened.

Mr. *Isaac Carr*, Engineer to the Widnes Corporation Gas and Water Department, said he considered the proposed alteration in quality would affect adversely every type of consumer; and he recognized no useful or economical purpose from the manufacturing point of view by reducing the illuminating power. The coal in Scotland was the best gas-producing coal in the kingdom, and easily lent itself to manufacturing gas of a quality very much higher than what was proposed in the Order. The selling prices in Widnes were 1s. 2d., 1s., and 10d. per 1000 cubic feet. If the "Metropolitan" argand No. 2 burner showed a candle power of 16½, the gas, as consumed in an ordinary good flat-flame burner, would only show 11·1 candles; and the gas recorded as equal to 14·6-candle power by the "Metropolitan" argand, was equal only to slightly over 9-candle power in an ordinary burner. If the gas in Edinburgh was reduced as proposed, the consumer, in order to get the same amount of light as now, would have to pay 6s. 7d., instead of 3s. as in the past. If the reduction was to 16½ candles, he would have to pay 5s. 4d. Having regard to the shrinkage in the calorific value, the extra cost in the case of 16-candle power would be 9·3d., and of 14½-candle power, 13d. This meant that a person now using 1000 cubic feet for cooking, and paying 3s., would, if the gas were reduced to 14·6 candles, pay 4s. 1d. for the same heat. He did not agree that, admitting a hardship upon flat-flame users, the reduction would be an advantage to those who employed incandescent burners. This was contrary to his experience. Each time, in his experiments (using the burner as the consumer would) that he substituted a lower-grade gas, he had to use a greater quantity, and the lighting efficiency went down. The ordinary consumer was not an expert, and could only use his burner under ordinary, not laboratory, conditions. Instead of a lower-grade gas being to the advantage of the consumer who had an incandescent burner, he would get out of the lower grade gas about 8-candle power per 1000 cubic feet less than at present; and if he had not an incandescent burner, but only a flat-flame, he would get out of it about 11 candles less than now. If he wanted the same light, he would have to pay more for it. This also applied to the use of gas for motive power, heating, and cooking. Any lowering of the quality meant an increase of the quantity. There were, moreover, many works where the incandescent burner was useless.

Cross-examined: He did not stand very much alone in the gas world in his opinions. An eminent engineer would follow him; and there were others who shared his views. It would not be an advantage to the consumer to use the common coal of the district to provide an efficient gas, without going to the expense of enrichment. The cost of enrichment to the authority was very much less than the advantage to the consumer; and to strip the gas of the enrichment now put into it would be to gain little, while the consumer would lose a great deal. Though he said he did not stand alone, his views were not the generally accepted views of gas engineers, nor of Parliament. He enriched his gas with benzol. Benzol carried. Incandescent burners gave a better light with less consumption.

Re-examined: Consumers had suffered by the concession of 14-candle power, which had led to the reduction in the candle power of the gas produced. There was no reason why it should be reduced in Edinburgh, and every reason for maintaining a higher quality than proposed in the Order.

Mr. *J. G. Newbigging*, Chief Gas Engineer to the Manchester Corporation, said that though the proposed reduction would involve depreciation all round, it would not be so perceptible in the case of the incandescent light. The reduction would practically preclude the employment of the flat-flame burner, the users of which would get no economic or efficient result from it. In many instances the flat-flame burner was the only possible one that could be used. This was the case in certain mills and foundries. The reduction would necessitate the consumption of more gas for heating, cooking, and motive power. It was ill-advised to propose such a drastic drop as from 20 candles to 14-candle power; and a large proportion of consumers would be injuriously affected. The users of the incandescent burner would suffer in luminosity, but not in pocket. If they distributed a gas of only half the value, and charged the same price, it stood to reason that somebody was to suffer. In Manchester, the gas was 17-candle power, and he did not think they would ever be so foolish as to go below that. It was all very well to go into the laboratory and make certain tests; but they must take the thing in every-day practice.

When the tribunal re-assembled on Saturday,

Mr. COOPER intimated that he did not propose to call the other expert witness he had—Mr. H. O'Connor, of Edinburgh.

Dr. *Hugh Marshall*, a Lecturer in Edinburgh University, stated that in December, 1903, great complaints were made by the public regarding the poor quality of the gas supplied to the city. He was waited upon by Mr. Brown, the then Treasurer of the City, and requested to make independent tests of the illuminating power of the gas, to find out whether there was any pronounced variation in the quality. He was told that the official tests were then showing about 25-candle power. He made preliminary tests of the gas as supplied to the University, and got what might be called extremely low results; and he then proceeded to make systematic tests. On Dec. 12 he got 17·3 and 16·6 candles; on Dec. 13, 16·8 candles; on Dec. 14, 19·8, 21·8, and 17·6 candles; and on Dec. 15, at a quarter to two in the morning 17·6, at about half-past nine 19·9, and at a quarter to four 20·2 candles. For the next few days, it kept fairly steady at about 20 candles. In view of these results, he asked that an official test should be notified; and he was told that this would be done within the next few days. On Dec. 19, at 3.15 a.m., he got 19·7 candles; at noon, 19·6; at 2.40 p.m., 20·2; at three, 22·9; at 3.30, 25·3; and at 8.10, 19·7 candles. On Dec. 20, the candle power was 20. On Dec. 21, at 10.15 a.m., it was 19·6; at noon, 19·5; at 2.50, 21·3; at 3.10, 22·7; and at 4.10, 20·9 candles. From that time till the end of December he continued making tests; and the power fluctuated round about 20 candles. It was only once 25 candles. On Jan. 1, 1904, it was 24·3 candles. In the second half of February, he was asked by the Town Clerk to carry out a similar set of tests for a Committee of the Town Council. He made tests on ten days; and the general result was about 20 candles, exceeded on one or two occasions. On March 1, he got 22·1 candles; and on March 29, 24·4 candles. Except on one or two occasions, the candle power was uniformly considerably less than what was reported in the official tests. Speaking generally, the calorific power of the gas diminished with the candle power.

Cross-examined: His tests were taken in the middle of winter. Gas of considerable richness, if transmitted a distance, would lose, but nothing to the extent indicated; nor would that account for the sudden rise of 4½ candles in the course of an hour-and-a-half, and a similar drop in the course of another hour-and-a-half. With gas such as was being supplied in Edinburgh, the loss was evidently negligible. The amount of loss would depend upon the constituents of the gas. If the luminosity were chiefly due to naphthalene, they might expect a considerable falling off; but if it were due to other causes, the falling off might be very small. So far as he knew, they were not troubled with naphthalene in the Edinburgh pipes. He did not agree that with gas of a lower candle power the loss in transmission would be very much less in proportion. This would depend entirely upon the nature of the gas. Some years ago, in connection with the question of introducing carburetted water gas into Edinburgh, he visited a number of gas-works in England; and he was told, in towns where they made gas of a lower quality than in Edinburgh, that they were troubled with deposition. It depended entirely upon the hydrocarbons in the gas—not exactly on the candle power, but upon what constituted the candle power. He held that there should be several testing-stations throughout Edinburgh. He believed that the loss was not largely due to the long travel of the gas and its excessive richness, but was due to variations in composition at the works. He was not calling in question the official tests. At the moment they were carried out, he believed they were correct. Most emphatically, he did not think that a lower grade of gas than 20 candles would carry better. The candle power of the gas might have been reduced since he made his tests; and he had not been asked to make any further tests. He did not know that the gas was any better now than at that time. It was the case that Mr. Herring wrote to him in April, 1904, asking to be allowed to inspect the photometrical apparatus in the University buildings. He had no power to do one thing or another in that matter. He said the University Court must be asked; and if the Commissioners made a formal application, he recommended that some neutral party should be allowed to inspect the apparatus and to report upon it. He quite believed that Dr. Crum Brown might write that the photometer-room was under Dr. Marshall's charge, and could not be shown without his consent. A formal request in writing for inspection of the apparatus was made this month; and his reply was that he had no authority in the matter. Besides, the photometer had not been required for some time, and was partly dismantled. He had no objection to Mr. Herring seeing the apparatus, either in 1904 or 1908. Photometers were nothing like so delicate as much of the apparatus he had to deal with; they were very simple.

By Mr. M'CALLUM: The conclusion he came to was that the gas was not always of the quality which it was on being tested.

Mr. *G. A. D. Mackay*, Inspector of Lighting in Edinburgh, said there were 6385 common stairs, of which 6301 were lighted by flat-flame burners, 72 with electric light, and 12 with incandescent gas-light, as an experiment. His opinion was that incandescent gas lighting was quite unsuitable for common stairs. The cost was, for the apparatus, 6s. 6d. each; and for fitting up, 7s. 10d. (both charged by the Gas Commissioners). These two sums represented an outlay of over £9000. Then most of the burners on common stairs lighted the flat above them as well as the flat below, which could not be done with incandescent lamps. Sweepings from the stairs would also get into the lamps and destroy them; even the flat-flame burners deteriorated from sweepings. It would require, he calculated, six mantles per lamp every year, whereas flat-flame burners lasted for years. An extra staff would also require to be kept for the lighting and extinguishing of the lamps.

Cross-examined: When it was proposed to substitute incandescent lighting in the streets for flat-flame lighting, he made experiments, and his report was at first unfavourable. He thought that Councillor Wilson, the Chairman of his own Committee, was mistaken upon the question of lighting common stairs by incandescent gas-lamps.

Mr. *David Rutherford*, Chief Sanitary Inspector in Edinburgh, said he had made a survey of various districts in the city, and found that the percentage of flat-flame burners was 60·53, and of incandescent burners 39·47. In cross-examination, witness said his examination did not amount to anything like a complete census of the whole city.

Mr. *J. M. Inglis* considered that the pipes in the buildings would be too small for supplying 14-candle gas.

Councillor *James Leishman* said there was in the Town Council a strongly unanimous opinion that the quality of the gas should be determined where the consumer got the gas. The City Chambers were in the centre of the city, whereas Granton was on the outskirts of the district. There had been for five weeks in the City Chambers a testing-station, duly fitted up with all the latest apparatus. Members of the Town Council were not experts upon burners; but they were informed that the argand burner was not a consumer's burner, but was purely a test burner, and that it would make a very great difference in the illumination. The proposal had not been made in the Town Council that the illuminating power of the gas should be reduced to 14 candles. It was his opinion that gas consumers should be protected; that was why the Corporation were there. He had a list of fourteen towns in Scotland, and there was not a 14-candle gas among them. In every case the gas supplied was considerably over the minimum.

The DEAN OF FACULTY (in cross-examination): Is there any good reason why Parliament should not place the confidence in the Edinburgh gas authorities which has been placed in other authorities—viz., that they will do an honourable thing?

Witness: My opinion is that the Gas Commissioners have been walking through their present Act of Parliament for the last few years. They maintain that "supply" means "supply at the works." Consumers in Edinburgh, according to my judgment and experience, have been profoundly dissatisfied with the Gas Commissioners.

Are not the Gas Commissioners the representatives of the consumers?—They are supposed to be; but I do not think they are at present.

Why do you distrust the common-sense of the consumers and also

the business capacity of the gas managers of the future, so as to tie them up, and fetter them in a way that Parliament does not fetter English authorities?—Our experience is that we have no control whatsoever over the Gas Commission. The Commissioners absolutely take no notice of us whatever.

Can you give any intelligible reason why the consumers in Edinburgh ought to be fettered with a different minimum standard from the consumers in other towns in the United Kingdom?—The general consideration which weighed with us was that for many years the consumers in Edinburgh had been accustomed to high-grade gas. I consider it would imperil the gas undertaking. There are two millions of money there which would be greatly damaged.

Mr. Herring said in his evidence that he did not think there was the slightest intention of immediately coming down to the minimum. Don't you think that is a wise and honourable position?—No; I think he should not ask the power at all. If he will take my advice, he will wait until the public are educated and he can prove that it ought to be as he says.

If there is any substance in your position, how do you account for the Town Council of Leith and the County Council of Mid-Lothian not opposing?—Leith is a much smaller place, and is nearer Granton. The County Council do not know anything about it. They are a very small body.

By Mr. M'Callum: If the low-grade-gas men were right in their contention that low-grade gas did not depreciate—which the plain, ordinary man could not understand—why were the Gas Commissioners frightened to allow a testing-place in Edinburgh?

Councillor *J. C. Chisholm* said that for many years there was a Cannel Coal Merchants' Association, of which he was Secretary; and he was also Secretary to the Arniston Coal Company, which produced the highest quality of gas coal. Their coal went to all parts of the world. He had examined the books of the Company to find the price of cannel. In 1893, it was 33s. 6¼d. per ton; in 1902, 25s.; and in 1907, 16s. 7½d. The prices were at the pit-head; and the railway charge between the pit and Granton was about 1s. 2d. per ton. The price of common coal had also gone down. His Company were prepared to supply the Gas Commission with any quantity of cannel at the rates mentioned. It had been offered to them. The testing-place ought to be in the City Chambers.

Cross-examined: He did not see that it would be unfair to the Gas Commissioners to have the official testing-place practically at the end of the supply, so long as they were providing a high-grade gas which might suffer in transit. He had had experience of gas in another town, and of official tests, as well as of independent tests taken away from gas-works, and he was sorry to say that the one had no relation to the other. The demand for gas coal for export had been decreasing. This was why it was expected that the price of gas coal would go down.

This concluded the evidence; and the Commission adjourned until Monday.

The Decision—Preamble of Order Proved.

After hearing Counsel on both sides yesterday, the Commissioners decided that the preamble of the Order had been proved, subject to additional daily tests of the gas at the City Chambers, Edinburgh, and at the Municipal Buildings, Leith. The effect of the decision is that the Gas Commissioners may supply gas of 14-candle power tested by the "Metropolitan" No. 2 argand burner, and the Corporations may establish testing-places which shall be deemed to be testing-places under the Gas Acts, and shall be in addition to the one at the Granton Gas-Works.

Automatic Public Lighting in Lambeth.

At the meeting of the Lambeth Borough Council on Thursday, the Lighting Committee reported upon the experiments undertaken by the Gaslight and Coke Company with the Rostin automatic system of lighting and extinguishing the public lamps. In October, 1906, the Council gave their sanction for experiments to be made with between 100 and 200 lamps in the district bounded by Lambeth Road, Westminster Bridge Road, Lambeth Palace Road, and a portion of Kennington Road; and the permission had been extended up to the present time. The Lighting Committee stated that they had had the experiment under careful observation, both as a Committee and individually. The Gas Company offered to extend the system to all the lamps within the borough, numbering 864, fix and maintain the apparatus at their own expense, and make a reduction in the charge for lighting and extinguishing the lamps, after the installation, of 1s. 6d. per lamp per annum, instead of 1s. as originally suggested. The Company also offered to undertake to remove the apparatus at their own cost, if at any time within five years it proved unsatisfactory; while at the end of five years, if the system was found to be as efficient and economical as was hoped, further reductions would be allowed in respect of the savings effected in lighting and extinguishing. The Company did not propose to discharge any of their employees consequent upon the adoption of the automatic system; but such vacancies as occurred in the ordinary way would not be filled. On the recommendation of the Committee, who considered the light given by the lamps fitted with the automatic apparatus as efficient as in the case of those not so fitted, the Council accepted the Company's offer. It was stated that the saving would be £60 per annum.

Merthyr and the Rhymney Water Company.—The Merthyr Water Committee have decided to offer the Rhymney and Aber Valleys Gas and Water Company the following terms for giving them a supply of water: A minimum of 60 million gallons per annum, at 5d. per 1000 gallons; any quantity between 60 and 80 millions, at 4¾d.; any quantity between 80 and 100 million gallons, at 4½d.; and any quantity above 100 million gallons, at 4d. The agreement is to be for 25 years; and the Company are to pay 10 per cent. per annum on the capital cost incurred by the Corporation.

LEYDEN MUNICIPAL GAS UNDERTAKING.

Report for the Year 1907.

We have received from Heer N. W. van Doesburgh, the Manager of the Leyden municipal gas and electricity undertakings, a copy of the very full report of the Managing Committee on the working for the year ended Dec. 31 last. In regard to administration, the Committee reported that it was decided by the Municipal Council to place the gas and electricity works under the same technical control, while keeping their financial administration distinct. Separate working accounts are, therefore, given in the report; but it is only proposed in this summary to refer to the accounts of the gas undertaking.

The Committee decided in February, 1907, in consequence of the rise in the price of coal, that it would be necessary to increase the price of gas by half-a-cent per cubic metre (2·83d. per 1000 cubic feet). The agreement between the works and the Dutch railway administration with regard to railway communication with the works, which was made in 1882, having expired, it was agreed that about two florins should be paid in respect of each 10-ton waggon, or the round sum of 4500 florins (about £375) per annum. Contracts were made for the supply for the twelve months ending the 31st of March last of 17,600 tons of Westphalian coal and 4000 tons of English coal, as well as a contract for the twelve months ending June 30 last for the supply of 800 tons of Texas gas oil. The contract was renewed with the Rotterdam Tramway Company for the delivery of coke. Contracts were entered into with Messrs. Burt, Boulton, and Haywood, Limited, for the purchase of the coal tar and the water-gas tar produced. The working of the undertaking for the year shows a net profit of 98,119 florins (about £8177).

The carbonizing plant comprises nineteen beds of eight retorts; the maximum number of beds in use at one time being seventeen, and the minimum eight. A special gas-meter, gas-engine, naphthalene washer, and a Roots' blower, capable of pumping 13,000 cubic feet of gas per hour against a pressure of over 47 inches, have been provided in one corner of the works for the supply of gas to holders in the villages of Sassenheim and Veoorschoten. The apparatus at the villages belongs to the local authorities there. The supply to both places commenced in October. The total amount of gas made during the year was 9,785,671 cubic metres (345,600,540 cubic feet), of which 19·76 per cent. was carburetted water gas, and the remainder coal gas. The make of gas per ton of coal amounted to 11,170 cubic feet, which is an increase of 2·36 per cent. over the yield obtained from the coal in the previous year. The total quantity of gas made showed an increase of 3·925 per cent. over the total make in 1906. The price of gas from the 1st of October last was 5½ cents per cubic metre (2s. 7d. per 1000 cubic feet), with an increase of 1 cent per cubic metre to prepayment meter consumers. At the end of the year there were 3289 of the latter meters in use. The unaccounted-for gas amounted to 5·95 per cent. of the make. The consumption of gas by private consumers per head of the population of Leyden was 140·67 cubic metres (4968 cubic feet). Out of 1300 street-lamps, only two appear still to have flat-flame burners.

Charters Towers (Queensland) Gas Company.

At the half-yearly meeting of the Charters Towers Gas Company, which was held on May 22, a very favourable report and statement of accounts were presented; and the Manager (Mr. Charles A. Watson) was thanked and congratulated upon the improved condition of affairs, despite the dull times. The consumption of gas for the six months ending April 30 was 3,853,000 cubic feet, as against 3,692,900 cubic feet for the corresponding period of the previous year. This gain of 160,100 cubic feet, the Directors remarked in their report, was the first increase experienced for the last four years. The receipts for gas were £2359, against £2300; while coke and tar realized £137, compared with £36. Manufacturing, maintenance, general expenses, and tools were £1464, against £1207. Of this increase, £182 was under the headings of maintenance and general expenses; and it was, the Directors stated, necessary in order to secure thorough efficiency in the works, plant, consumers' meters, &c. The amount brought into the half year was £2458, and the receipts of the six months added to this made a total of £5029. Out of this, a dividend of 6d. per share (5 per cent. on the capital, which is in 10s. shares), absorbing, with income-tax, £1050, had been paid. The expenses of the half year were £1642, which left a balance of £2337, out of which the Directors recommended the payment of another dividend of 6d. per share, equal to 10 per cent. per annum—leaving £1287 to be carried forward.

Workington Gas Supply.—The Manager of the Workington Gas-Works (Mr. George Keyte) has presented to the Gas Committee of the Corporation his report for the year ending March 31 last. It is accompanied by the balance-sheet prepared by the Borough Treasurer (Mr. J. Noble), which shows that the gross profit amounted to £3788, and the net profit to £1575. The expenditure was £13,460, against £12,831 for 1906-7. The increase of 3s. 3d. per ton in the contract price of coal raised the expenses by £816; but there was a saving in manufacturing charges and in the renewal of the public lamps, which reduced the net increase to £629. The income totalled £17,248, being £1279 more than for the previous year. The additional income was principally due to the increase of 2d. per 1000 cubic feet in the price charged for gas since last July, and to the extra quantity sold. The total bulk of gas made was 103,872,000 cubic feet, of which 86,027,200 cubic feet were sold (63,188,200 cubic feet by ordinary and 22,839,000 cubic feet by prepayment meters), 10,475,400 cubic feet consumed by the pubic lamps, and 1,278,400 cubic feet used in the works and office. The total accounted for was 97,781,000 cubic feet; leaving 6,091,000 cubic feet unaccounted for, or 5·86 per cent. There were 9658 tons of coal and cannel carbonized; the average quantity of gas made per ton being 10,755 cubic feet. The coke available for sale was 8·47 cwt. per ton of coal; the tar made was 11·55 gallons per ton; and the sulphate of ammonia, 25·65 lbs. per ton.

INSPECTION OF GAS LIQUOR AND OTHER WORKS UNDER THE ALKALI ACT.

Report to the Secretary for Scotland.

Our readers are aware that the portion of the work of the Chief Inspector under the Alkali Act (Mr. R. Forbes Carpenter) carried on north of the Tweed is made the subject of a special report to the Secretary for Scotland. From this we give the following extracts to supplement those already taken from Mr. Carpenter's reports to the Local Government Board.

The details of the work done are, as usual, presented by Mr. W. S. Curphey, the District Inspector, who says the number of works registered during the year ending the 31st of December last was 158, which is an increase of 15 over the number for 1906. The processes under inspection were 260, compared with 219 in the preceding year. The make of salts of ammonia (expressed as sulphate) was as follows:—

	Tons.
Gas liquor works	18,340
Iron-works	19,719
Shale-works	51,338
Producer-gas, coke, and carbonizing works	13,945
Total	103,342

In 1906, the production was 98,245 tons. In the course of inspection, 525 visits were paid, and 497 examinations were made of the gases passing away from the various works. The general average escape of acid gases from all the sulphuric acid works was equivalent to 1·17 grains of sulphuric anhydride per cubic foot of total escaping gases. The figures are well within the maximum limits prescribed by the Act. The number of registered works in Scotland in which sulphate, chloride, or hydrate of ammonia was made during 1907 was 89; being five more than in 1906. The increase was due to four works in which plant for the manufacture of sulphate from gas liquor was put into operation, and one in which the recovery of ammonia from producer gas was started. This class of works now comprises 16 iron-works, 13 shale-works, 9 coke, gas-producer, or carbonizing works, and 52 liquor-works—one being both a carbonizing and a liquor works.

The practice of distilling ammoniacal liquor in gas-works, instead of sending it elsewhere for treatment, continues to extend; and Mr. Curphey says a further increase in the number of such works is probable. This is not necessarily attended with an increased production for the country, as the following figures show. The gradual increase in production is to be attributed to the growth of the gas industry and to advance in methods of purification, rather than to an augmentation in the number of works.

Year.	Number of Works.	Tons of Sulphate Produced.	Year.	Number of Works.	Tons of Sulphate Produced.
1898	30	14,675	1903	37	16,675
1899	30	14,742	1904	40	16,685
1900	31	15,736	1905	42	17,953
1901	32	16,122	1906	47	18,287
1902	35	18,205	1907	52	18,340

Thus in the period of ten years reviewed there has been an increase of 73 per cent. in the number of works and of 25 per cent. in production. The average production per works was 489 tons of sulphate in 1898, against an average figure of 353 tons in 1907.

The following statement gives particulars regarding the methods of utilizing gas liquor and the means employed for dealing with the noxious gases evolved: Number of works using continuous distillation plant, 51; do. using intermittent plant (in one works, both methods are employed), 2; proportion of liquor distilled by the continuous process, 97·7 per cent. The sulphuretted hydrogen evolved in the process of manufacture is dealt with at the various works as follows: By the Claus process, 1; by oxide purifiers, 48; by combustion, 3; and by metallic salts or other methods 32. In two of the works using the combustion method, a portion only of the waste gases is so dealt with. The balance is taken to oxide of iron purifiers. In another works, the gases are partly dealt with in purifiers and partly removed by metallic salts. The sulphuretted hydrogen evolved in the process of manufacture is dealt with by the various methods in the following proportions, expressed in terms of sulphate of ammonia and in percentage of the total make: By the Claus process, 11·9; by oxide of iron purifiers, 76·9; by combustion, 8·4; and by metallic salts or other methods, 2·8. These figures do not include the ammoniacal liquor obtained in iron-works, shale-works, or coke-oven and producer-gas works. In these, the continuous process of distillation is universal; while the method of disposal of the waste gases is influenced by the class of works. In iron-works and producer-gas works, the waste gases are practically free from sulphuretted hydrogen; in shale-works they are led into the retorts; and in coke-oven works they ultimately pass into the uncondensed combustible gases which are used for fuel.

The production of sulphate of ammonia in Scotland from all sources shows an increase over 1906, and amounted last year to upwards of 103,000 tons. This increase is chiefly due to operations in shale-works and producer-gas works. In liquor-works the increase was trifling; while in iron-works the production did not come up to the level of 1906. In shale-works the year was an active one, with increased production in the works previously in operation. In producer-gas works the increase is in part due to increased recovery plant being in operation owing to one additional works having started. The decrease in the yield from iron-works reflects a slackness observable towards the end of the year, when blast-furnaces were being laid off.

The number of registered works in which tar was distilled last year was 40—the same as in 1905. No change took place in this class of works during the year. In works dealing with tar resulting from gas manufacture, lime purifiers continue to be the means in most general use for dealing with the noxious gases produced. A mixture of oxide of iron with lime is employed in some cases; while in others the gases are led into ordinary oxide of iron purifiers after mixing with the waste gases coming from sulphate of ammonia plant. In iron-works producing pitch, the most general method is to return the waste gases from the tar-stills to the gases coming from the blast-furnaces, when they again pass through the recovery plant to part with any ammonia, oil vapours, &c., which they contain.

Mr. Carpenter expresses his pleasure in reporting that the supervision of the chemical operations described by Mr. Curphey was effected last year without proceedings being taken against the owner of any works for infringement of the statutory obligations with regard to the discharge of acid or noxious gases, to non-observance of which penalties attach.

Referring to Mr. Curphey's observations on the production and recovery of ammonia in the various industries in Scotland which contribute in so large a measure to the total produce of this valuable material in the United Kingdom, Mr. Carpenter points out that the amount, expressed as sulphate, exceeds 100,000 tons in the year under review—a figure never before reached, and forming nearly one-third of the whole produce of the United Kingdom. The contribution to the Scotch total by paraffin oil works distilling shale forms more than one-half of the above-named figure, and amounts to one-sixth of the national yield. This industry is confined to Scotland. The coal-fed blast-furnaces in Scotland contribute nine-tenths of the total produced in iron-works.

In continuance of the table presented in recent annual reports of the progress of shale distillation and ammonia recovery, Mr. Carpenter gives the following figures, compiled from the statistical returns to the Home Office on Mines and Quarries, for the last ten years to Dec. 31, 1907:—

Year.	Total Shale Mined in the United Kingdom.	Total Sulphate of Ammonia Recovered from the Shale.	Yield per Ton of Shale Mined.
	Tons.	Tons.	Pounds.
1898	2,137,993	37,264	39·0
1899	2,210,824	38,780	39·3
1900	2,282,221	37,267	36·6
1901	2,354,356	40,011	38·2
1902	2,107,534	36,931	39·3
1903	2,009,602	37,353	41·6
1904	2,333,062	42,486	40·8
1905	2,496,785	46,344	41·6
1906	2,546,522	48,534	42·7
1907	2,675,989	51,338	43·0

Mr. Carpenter states that up to the introduction of the improved system of retorting, which in the period since 1868 has attained such marvellous technical perfection, the yield of sulphate of ammonia from the shales at that time in predominant use was 12 lbs. per ton of shale retorted. These shales are poorer in nitrogen and richer in oil than those mined from greater depths in predominant use last year; so that all increase must not be attributed to improved methods of retorting. He referred to this in the portion of his report to the Local Government Board headed "Studies in Coal Carbonizing" (see *ante*, p. 112). He thinks it will be of especial interest to chemical technologists in Scotland, who have devoted so many years of careful work to the development of plant, followed by the attainment of these magnificent results, to learn that very considerable progress has been made, both in England and on the Continent, in applying the system of carbonizing coal in vertical retorts for the production of illuminating gas.

Little change took place during the year in methods for dealing with the noxious and offensive gases evolved in the course of these manufacturing operations. In gas-works, the methods in use for arresting the sulphuretted hydrogen constituent of these gases are varied, as indicated by Mr. Curphey in the present and in previous reports. In Mr. Carpenter's report for 1906, reference was made to the amounts of ammonium cyanide often existing in ammoniacal liquors distilled, especially in those from coke-oven works, where the proportion of hydrocyanic acid in the gases leaving the saturators might reach a highly dangerous figure. Many experiments have been made in the direction of converting this ammonium cyanide into non-volatile cyanogen compounds, so that the cyanogen remains in the liquors when these are distilled, and does not pass away with the volatile ammonia to the saturator, where sulphate of ammonia is formed. In the Scotch works of this class, care is taken to provide such means of exhaust as to always maintain a suction on the saturator, so that, in case of leaky apparatus, noxious gases would not escape, but air would be drawn in. The gases, eventually, after re-scrubbing, pass with the gases used for maintaining combustion in the oven flues. Here all hydrocyanic acid is destroyed as such; passing into the atmosphere in the innocuous forms of water vapour and carbonic acid. At the same time, the sulphur impurity escapes as another noxious gas, sulphurous acid. On the amount of acidity arising from this source, a watch is maintained by the application of direct test by the inspector.

Mr. Carpenter next offers the following observations on a subject to which the attention of our readers has already been directed:—

Mr. James M'Leod, late of the Provan Gas-Works of the Glasgow Corporation, and now of Kirkintilloch, has contributed many data to our knowledge—firstly, of the redistribution of the nitrogen in the distillation of certain Scottish coals; and, secondly, of the relative rate of absorption of gaseous impurities, including cyanogen compounds, from crude coal gas, the product of such distillation, in the washing apparatus forming part of the equipment of the Provan Gas-Works plant. In the first of these papers,* Mr. M'Leod presented the results of his examination of a number of Scotch coals from different sources; and from the averages of them he compiled a table showing the percentages of total nitrogen to be as follows: In the coke, 58·3; in the tar, 3·9; in the ammoniacal liquor, 17·1; in the cyanogen, 1·2; in the gas (by difference), 19·5.

The results, however, need a little qualification in description. Under "Nitrogen in Ammoniacal Liquor," Mr. M'Leod includes nitrogen as ammonia only. Knowledge of the amount of nitrogen present as cyanogen compounds, volatile and non-volatile, in combination with the ammonia, is needed before the amount could be considered as correct. Again, "Nitrogen in Cyanogen" refers only to that portion as hydrocyanic acid extracted from the gas by the application of the Foulis process by recovery, not to the total quantity of cyanogen leaving the retort in the crude gas. In the Foulis

* See "JOURNAL," Vol. XCVII., p. 748.

process, all ammonia is first extracted prior to the application of means for absorbing hydrocyanic acid from the gas; with the former, some, at any rate, of this latter constituent is removed in both volatile and non-volatile form. The value that attaches to the results presented proceeds from the fact that the calculations are based on averages of tests on over a quarter-of-a-million tons of coal, and are spread over a whole year of work.

To the second paper I can make but the briefest reference, interesting as it is. Mr. M'Leod delivered this as his Presidential Address at the annual meeting of the Scottish Junior Gas Association (Western District) in October, 1906.* Incidentally, Mr. M'Leod notes the reversion of cyanogen to ammonia in the cyanide scrubber of the Foulis process: "There is always some ammonia in these liquors of the Foulis cyanide process. Tests showed an increase of ammonia at the outlet of the cyanide scrubbers, though the gas was free from ammonia on leaving the ammonia scrubbers."

In Mr. Carpenter's report for 1904, mention was made of the starting of the first gas-engine of considerable dimensions erected in Scotland working on blast-furnace gas. He says that various vicissitudes have attended the career of this engine; but it is believed that all difficulties are now overcome. Early in the current year, the second (of a different type) was expected to be ready to start at another blast-furnace works. Its working will be watched with great interest, seeing that considerable knowledge has been acquired of the weak points of these large engines. Concerning one point mentioned in 1904—the removal of all tars from the gases before they are led into the cylinder of the engine and compressed—Mr. Carpenter remarks that perhaps the Feld washer, mentioned in his report to the Local Government Board (see *ante*, pp. 99, 161, 228), "might receive some attention at the hands of owners and managers of works contemplating the adoption of gas-engines utilizing producer gas or blast-furnace gas, as being specially adapted for the removal of these troublesome last traces of tar."

In estimating the effects of the incidence of the Act of 1906 in bringing under inspection various new scheduled and registrable processes, Mr. Carpenter says the subject divides itself into two sections: (1) New works coming for the first time for registration; (2) additional scheduled or registrable processes in works already on the register. Thirteen such processes in twelve works were registered and were registrable in Scotland for the first time last year—viz., two smelting, two sulphide, one alkali waste, and eight bisulphide. Under the second head, there were 15 processes falling into the category of processes added to certificates of registration already in existence, but registrable for the first time in 1907, and, in addition, 14 which were formerly included as sulphuric acid works, but are now separately scheduled.

Though not numerically the most important, paraffin oil works form the most important addition to the schedule. There are five of these processes added to the certificates of works already in existence as sulphate of ammonia works, operating, too, on a very extensive scale. These are works where the refining of paraffin oil is carried on. The inspectors had no right of supervision of these processes under the Acts of 1881 and 1892; but, in consequence of the noxious gases evolved in the operations (comprising sulphuretted hydrogen among others), these works have been added to the schedule of the Act of 1906. After the passing of the Bill, a conference was convened in Glasgow for the interchange of views between the manufacturers on the one hand and the Department on the other, which has been of considerable value, since it enabled the former to obtain the experience of the Department in other, but cognate, industries already scheduled and under inspection; while it enabled the Department to learn more in detail the difficulties to be overcome, and the special conditions of the case resulting from the physical and chemical characteristics of the mixture of compounds to be dealt with.

Mr. Norman Henderson, the Manager of the Broxburn Oil Company, attacked the problems in his own way, and sent to Mr. Carpenter the following interesting account of the successful solution of the difficulties as regards dealing with the gases from the continuous crude oil stills which form by far the largest bulk to be disposed of:—

> I am glad to say we are now recovering all the crude oil still gases which used formerly to go waste into the atmosphere. We get about 60,000 cubic feet of good, rich illuminating gas daily, or about 1¼ cubic feet of gas for every gallon of crude oil put through. I have now stopped working our gas-works and am using this gas alone for illuminating the village and our works, with great success. The gas being too rich for incandescent burners, I have to add a large proportion of air, which is cheap to us, and quite suitable for the purpose; the proportion of air mixed being measured by a meter, so as to make our gas uniform. The remainder of the gas which we cannot use at the gas-works is used as fuel in our still furnaces. Besides the gas recovered daily from the hydraulic main, I get about 150 gallons of light naphtha, which can all be turned into motor spirit. This naphtha is recovered in the hydraulic main by the friction of the gas through the water-lute. The naphtha comes over with the overflow water of the hydraulic main, and is easily separated by an ordinary separator and collected in a receiving-tank. We have tried further scrubbing of the gas, but find that it gives very little more naphtha than what is got in the hydraulic main. I am now considering the question of recovering the gas from the residue stills on the west side of the works. I may also say that I have taken out a provisional patent for this process, so that it is now quite secure.

Mr. Carpenter remarks that the circumstances of the close proximity of the village of Broxburn to the refining-works of the Broxburn Oil Company largely favours the method adopted by Mr. Henderson, since he already possesses a small gas-works where coal is carbonized, from which he used to supply the village as well as light the Company's works. He adds: "It is pleasant for the inspector to be met fully half way in his endeavours to administer the provisions of a new Act by the hearty co-operation of the manufacturers; Mr. Henderson having, after several consultations with myself and Mr. Curphey, designed this special plant, made all the necessary experiments to determine the data required prior to its design, and carried out its erection—undertaking all the responsibility. Had failure occurred, the responsibility would have been his. As success in no small measure has rewarded his efforts, the results must be all the more gratifying to Mr. Henderson."

Mr. Carpenter concludes his report with an appreciative notice of the life-work of the late Mr. William Young, of Peebles, and with a reference to his technical achievements, and to the inspiring influences of his labours upon all chemical technologists engaged in the study of the complex problems presented for solution in the process of the destructive distillation of coal and liquid hydrocarbons and the distillation of shale for paraffin oil with the recovery of ammonia. After quoting from Mr. George Beilby's "Thirty Years of Progress in the Shale Oil Industry," some passages bearing upon Mr. Young's work in association with the author, in the distillation of shale, Mr. Carpenter says:—

> In the latter years of his career, Mr. Young's thoughts turned to developments in the industry in which he began life—the gas industry. His contributions to the knowledge of destructive distillation, and to the principles underlying the application of heat to coal to obtain the various values, illuminant and calorific, in the gas evolved, are well known and widely appreciated. One dominant characteristic of his nature was enthusiasm. This quality, under the direction of a piercing intellect, will carry a man far—sometimes, indeed, too far for others to follow him; so that he stands alone for a time. And so William Young often seemed to stand alone, for his ideas were in advance of his times. . . . In his home at Peebles, his mind was always actively engaged on the problems that are now, and to a still greater extent in the near future will be, engaging the attention of the advanced section of technologists and engineers in the gas industry. To that home came many such seeking advice and the advantage of personal contact with a mind so fruitful in suggestion, so well stored, and able to illustrate suggestion by experience won in the course of his busy life. One of the privileges of the last ten years in my visits to Scotland, and one that I every year looked forward to with zest, was a visit to talk over with Mr. Young the technical problems both of the present and of the future that claimed our attention—in my own case departmentally, or by correlation with departmental work; in his case as the expert and the seer. . . . To the papers he contributed to the "JOURNAL OF GAS LIGHTING" in the early months of 1906, I desire, in conclusion, to direct attention as representing his latest ideas concerning the lines, in his opinion, most likely to be followed with advantage in the retort-house in the near future in the gas industry. That that future is near at hand will be seen by reference to the section in my report to the Local Government Board already referred to under the title "Studies in Coal Carbonizing."

* See "JOURNAL," Vol. XCVI., p. 178.

BRITISH FIRE-BRICK AND RETORT MAKING.

Radical Improvement Declared Necessary.

In the July number of the "British Clayworker" there is reprinted the paper on "Refractory Material" which Mr. F. J. Bywater, of Birmingham, read at the recent meeting of the Institution of Gas Engineers; and in another part of the same issue there appears an account of an interview with Mr. Bywater, together with our contemporary's comments on the subject. The latter article is in the following terms.

In Mr. Bywater's experience, the gas-retorts made in this country are not sufficiently durable—lasting as they do only 700 to 1000 days, compared with imported retorts, which last upwards of 2000 days—and they prove far more costly in use than are the retorts of best German make. That this difference in quality is due to original costs being materially different in the two countries, Mr. Bywater thinks is improbable; and in any case, he says, gas engineers are quite prepared to pay slightly higher prices if they can only get retorts locally which are as durable as those made abroad. "It is not so much the first cost of the retorts that is important to the engineer," Mr. Bywater continued, "but the length of time a retort can last in use and the number of days it has to be worked before it is convenient to let it down for replacement. The escape of gas which occurs in a leaky retort which must be worked because it would disorganize the works too much to stop using it, is a serious source of loss; and when the effective life of a retort made in this country is compared with that made abroad, the advantage is all in favour of the foreigner." As an instance of the comparatively secondary importance of the cost of the retorts, provided their quality is right, Mr. Bywater stated that segmental retorts, though far more costly to erect, really effected a saving of 1d. to 1½d. per ton of coal carbonized, as they lasted so much longer than the ordinary retort made in this country. In speaking of British refractory materials, it should be understood that Mr. Bywater refers chiefly to those made in the Midlands, as he has little or no experience of North Country goods, the carriage on which, he thinks, is too heavy to permit them to enter into active competition with local firms.

Asked to suggest means by which the retort and fire-brick manufacturers could improve their products, and bring them more into line with the imported ones, Mr. Bywater said that "the real difficulty is that our British makers lack combination, and consequently they do not know enough about the materials they use." He illustrated this by a number of actual examples which need not be detailed here, but which certainly tend to confirm his statement. "The German manufacturers have united themselves together, and have formed a union which supports a testing-station and an investigation department, in which careful studies of the properties of the different clays are undertaken, and an endeavour is made to assist each manufacturer to improve the product of his works, as well as to assist special men to produce mixtures designed to meet exceptionally trying conditions. The manufacturers in this country must do the same if they are to make any progress with their work. What has really happened is something like this: The older firms are rapidly nearing the end of their deep mine clay, and are finding it necessary to substitute new mine clay for old. They do not fully investigate the properties of the newer clay, but in a rough way 'open it out' with sand or other non-plastic material, and are, generally speaking, 'working in the dark.' The Germans start with a raw material distinctly inferior to much of that used here; but by careful investigation they make a far superior product."

Questioned further as to the composition of retorts and fire-bricks for gas making, Mr. Bywater admitted readily that a coarse-grained Stourbridge clay, with a liberal proportion of pot-clay, was practically ideal, but contended that the makers were not sufficiently acquainted with the real composition of their clays to be able to make the best use of them. He scorned the usual report of analysis which many makers offer in support of their goods, and showed its utter uselessness. This

is a subject on which we can thoroughly agree with him; for we have pointed out repeatedly that an analysis conducted by an ordinary chemist or public analyst may more often than not prove actually misleading to a manufacturer of refractory goods.

Turning to the subject of size of grain, Mr. Bywater agrees that much more care may reasonably be taken by manufacturers in this country to sort out the clay into certain sizes, and to mix these sorted clays in definite proportions, instead of adopting the present method of using a single riddle. It is certainly a fact that much better results can be obtained when the materials are more carefully separated into grains of certain sizes than when the present method is adopted. This can be readily seen by examining a clay ground to three different degrees of fineness, and heated for some time to 3000° Fahr., when the finest ground will be found to be vitrified, the medium ground less vitrified, and the coarsest material unaffected by the heat. Yet how few manufacturers really study this aspect of the question systematically, and have proved for themselves that their materials are sorted and mixed in the best possible manner!

Mr. Bywater's main suggestion is one with which we thoroughly agree in principle, though we do not see how it is to be effectively carried out in practice. He considers that the salvation of the fire-clay trade lies in the manufacturers carrying out a very complete series of investigations as to the real composition of their clays—ascertaining for each seam or pocket the proportions of felspar, quartz, and clay substance present, on the lines suggested many years ago by Seger and other famous scientific clay-workers, and by a series of actual tests made on a sufficiently large scale, under men who are able to carry out the investigation with proper scientific accuracy. This is the method adopted by our German colleagues with conspicuous success; and there is no doubt that, could the money be found for the purpose, and the work placed under the charge of the right man, equal, if not greater, benefits could be obtained here.

The subject of clay-working for refractory purposes is exceedingly complicated—far more so than most people are aware. It is, however, of such vital importance to this country's industries that fire-clay products should be made here, that it would be well worth while for the manufacturers to unite and see what can be done. We do not think that Mr. Bywater's suggestion of a department at Leeds University would be satisfactory, as the man required for this work should be a practical man, as well as one fully qualified on the scientific side, and one able to work in the factories as well as in his own laboratory. We do not think there are any works in this country of sufficient size to justify the appointment of a man of this type for their exclusive use. Such a factory as the one at Stettin is far larger than any in this country, and can easily keep a number of highly-trained men at work on investigation. But if several of the larger works in a district such as Stourbridge could combine, and share the expense as well as the information between them, it would be to their mutual benefit. The extent to which they might feel inclined to make the results of their investigations public property is a detail which could be settled later, and depends on the magnanimity of the manufacturers concerned. Even on a purely financial basis, however, the experiment would be almost sure to pay in the long run, though it might not do so at first, as there is so much leeway to make up.

While differing from Mr. Bywater in some of the details of his paper, we believe he has rendered a real service to fire-clay manufacturers in pointing out the direction in which further progress lies. We do not care to follow in the lead of another nation, for we believe that in many ways we are superior; but the idea that "progress comes from exact knowledge" is not confined to any country, and in carrying out a systematic investigation of the fire-clays of certain districts with a special view to obtaining from them the greatest advantages possible, we are only continuing on lines which our country had made famous long before systematic investigation was carried out abroad. Consequently, without quibbling about trifling details, we endorse Mr. Bywater's view that "a thorough investigation and proper treatment of the excellent fire-clays which exist in this country, many of which at the present time are entirely unworked, will restore British fire-clays to their pre-eminence for refractory purposes," because we start under more favoured conditions as to raw material, and our workmen are, broadly speaking, inferior to none in the thoroughness and skill with which they carry out their work when once the correct methods of procedure have been shown to them.

The question is, "Who will be foresighted enough to take advantage of the opportunity which is now waiting to effect a radical improvement in retorts and fire-bricks?

GAS-WORKS EXTENSIONS AT WALLASEY.

Local Government Board Inquiry.

Mr. A. W. Brightmore, on behalf of the Local Government Board, last Tuesday held an inquiry at Egremont into an application by the Wallasey Urban District Council for authority to borrow £64,821 for necessary extensions in connection with the gas undertaking.

Mr. H. W. Cook, the Clerk to the Council, stated that the amount applied for was made up as follows: £26,933 for retort-house, purifier-house, meter-house, condensers, tar-extractors, &c.; £21,000 for mains, services, meters, and cookers during the ensuing three years; £6888 for gasholder, tank, &c.; and £10,000 for cookers. There were now either on hire or hire-purchase 8421 cookers, which were bringing in a revenue from gas consumption of a varying amount per annum. The value of the cookers was estimated at £18,500, in respect of which the Council had only borrowed £5000. The Council therefore considered it reasonable to ask the Local Government Board for permission to borrow £10,000, leaving outstanding the sum of £3500 to be paid out of revenue. In October last the Council applied for power to borrow £70,020 for extending the gas-works; but the Local Government Board considered the application should be limited to the sum of £26,933 for buildings, plant, &c., and the amount estimated for services, meters, cookers, &c., during the next three years. The present application, was, therefore, for power to borrow £26,933, *plus* the estimated cost of mains, services, meters, and cookers, the balance of the cost of a gasholder tank, &c., and the sum named for cookers. This would appear to be the minimum amount with which the Council could continue to meet the demands upon them until the year 1915, assuming a continuance of the present rate of increase in consumption. The Board were asked to allow the longest period for repayment of the loans, as, owing to the abnormal growth of their district and all its undertakings, the Council had borrowed during the last ten years by far the greater proportion of their debt; and it was only reasonable that the burden should be equitably apportioned.

Among those who gave evidence in favour of the application were Mr. J. H. Crowther, the Engineer, Mr. W. Eastwood, the Chairman of the Gas and Water Committee, and Mr. S. S. Dawson, the Chairman of the Finance Committee. Mr. Dawson stated that the extensions were absolutely necessary, and there was no ground for suggesting that the Council were incurring more debts than they should. The manufacture of gas in Wallasey compared more than favourably with Liverpool. They sold their gas at 2s. per 1000 cubic feet, as against Liverpool's 2s. 6d. During the last eleven years, there had been £134,000 transferred to the rates from the undertakings generally. With regard to the Council's undertakings as a whole, the outstanding capital in March, 1907, was £745,538. Out of the trading profits of the year they paid off capital to the extent of £32,258, and transferred to the rates £14,862, making a total of £47,120, or 6⅓ per cent. of the total capital or loans outstanding. The district's debt in March, 1907, was £1,251,701; and if they deducted from this their productive debt of £745,538, it left a net debt of £506,163, against a rateable value of £420,000. Excluding the debt on education, the productive debt was just the amount of their rateable value.

UNPROFITABLE ELECTRICITY AT TONBRIDGE.

The affairs of the Tonbridge Urban District Council's electricity undertaking suffered some damaging criticism in the course of a Local Government Board inquiry, which was held last week by Mr. H. R. Hooper, relative to an application by the Council for sanction to borrow £4200 for extensions. Mr. M. P. Plunkett, the Electrical Engineer, said there had been a steady improvement in the revenue each year; and though it was not yet possible to meet the whole of the loan charges, there was every prospect of being able to do so in the near future, as fresh consumers were constantly being connected. Mr. H. W. Peach, the Clerk to the Council, remarked that last year a profit was made of £1100, about £400 of which was actually invested in the undertaking, which, he was convinced, would eventually relieve the rates. The Inspector: Do not let us talk of that. An electricity undertaking is not started with that object; the first thing is to put it in a sound condition. You have been going on for about six years, and there is not a half-penny for depreciation.

In cross-examination by Mr. S. P. J. Merlin, who appeared in opposition on behalf of a large number of ratepayers, Mr. Plunkett stated that the average life of electric plant could safely be put at 20 years. The Council were allowed 25 years to repay the loan; so that before the plant was paid for, it would be useless. But there was the scrap value. He did not know that there had been an increase of £600 in the cost of public lighting in Tonbridge for the year. One-third of the total number of units was used for public lighting. The gross cost was 5·7d. per unit. Some of the current was supplied at 3d. per unit; but he did not agree that 50 per cent. of the total current was being sold at 50 per cent. of its cost. The proportion of electricity consumers was under 10 per cent. of the ratepayers. For each one who used the electric light, nine others were assisting to pay for it; but they got the benefit of the public lighting. The Gas Company had laid a high-pressure main in High Street; but the electric light had since increased. The tradesmen at first gave up electricity for high-pressure gas; and this the Council met by reducing their charges for outside lighting to 3d. per unit. Some of the tradesmen gave up the 6d. per unit supply inside, and lit their shops with the 3d. per unit supply outside. The electric light consumers in Tonbridge were generally of the better class, and tradesmen; and it followed that the poorer ratepayers had to help to make up the loss.

The Chairman of the Finance Committee, Mr. G. F. Stacey, said the undertaking had been gradually growing; and he believed that by 1911 they would have turned the corner. Mr. Isaac Race, the Chairman of the Electricity Committee, raised a laugh by the novel statement that a "lot of electric lighting plant was practically everlasting;" to which the Inspector retorted, "and new machinery is constantly being invented." Subsequently the Inspector emphasized the need for a depreciation fund, in addition to capital repayment; remarking that no electricity undertaking in the country could exist without one.

Mr. Merlin submitted that, on the evidence of the Council's own accounts, the loan should not be granted. It would involve a further liability on the undertaking, and indirectly on the ratepayers, of £400 a year. This outlay was absolutely certain; but the return for it was very problematical indeed. Half cost price was charged for 75,000 units sold, which was commercially unsound and economically vicious. They could not hope, moreover, for better results in the future, unless they gave up the non-paying part of the business; and this he would press on the notice of the responsible authorities. Who paid for the unsound methods of business? The ratepayers, 90 per cent. of whom could get no return except a share in the general benefit of public lighting. Was it fair that the general body of ratepayers in Tonbridge should have to pay for the luxury enjoyed by 10 per cent. of the better class? There was a practical and commercial alternative—viz., that the electric lighting department should cut off the non-paying part of the business, and stick to the reasonable and legitimate paying business, which only represented 50 per cent. of the output. The present system amounted to nothing more than a false Socialism—Socialism of the most vicious kind—and the undertaking had no prospect but of being a permanent burden on the rates, unless there was a radical change of management.

Mr. Peach said he was disappointed and surprised that no evidence was called by the opposition. The plant was being used up to the hilt; and the need for the loan was very pressing. He hoped therefore that the Inspector would see his way to advise the Local Government Board to grant the application.

UTILIZATION OF TAR.

In the last number of the "JOURNAL" (p. 188), we noticed a paper read by Mr. G. S. Brodie, the Borough Surveyor of Blackpool, at the congress of the Royal Sanitary Institute at Cardiff, on "The Best Method of Mixing and Laying Tar Macadam for Streets and Main Roads." In the course of the proceedings at the congress, the question of the utilization of tar came up in various discussions.

Mr. Reginald Brown, M.Inst.C.E., the Engineer and Surveyor to the Southall-Norwood Urban District Council, dealing with the surface treatment of roads with reference to laying dust, said that some fear had been expressed that if the treatment of roads by tar painting was generally adopted, there would be insufficient tar to meet all requirements. To ascertain the truth in the matter, he had worked out the quantity of tar produced in England and Wales from published records of the production of coal gas in the country, and found the total to be approximately 164 million gallons. If each square yard of roadway required an average of one-eighth of a gallon, the mileage of roads, calculated at 8 yards wide, would represent over 93,000. There would consequently be more than sufficient. Oil tar was the bye-product of the manufacture of gas from oil, and varied in its composition according to the temperature of production, the nature of the retort or producing plant, and of the oil used. It was of an extremely complex nature. A very much smaller quantity of oil tar than coal tar was produced in the country. It was owing to the lower production and the want of uniformity in the constitution of the product that oil tar had not been studied to nearly the same extent as coal tar; and there had been even some doubt as to what the chief constituents were. While the bulk of coal tar found its way at present into the distillers' hands, oil tar was generally employed as fuel. He was particularly interested in this material, as he had used it largely for the past two years; and, so far as he knew, his district was the only one in which oil tar was applied to all the streets, and water-carts had been abandoned. Oil tar, as generally obtained, was very little used by distillers owing to the large amount of water (something like 75 per cent.) it contained; but where the material was required for fuel, the water was eliminated as far as possible, and one was able to obtain a liquid containing only a small percentage of water. A considerable quantity of this material—something like 17½ million gallons—was produced every year. From extended experiments, it had been found that four dressings were required for each watering season, and that, on an average, one gallon would cover 10 yards. The production would therefore surface some 300 miles of road, taking the width as 8 yards. The cost of surfacing roads with oil tar averaged 1d. for four dressings, and this worked out at £58 13s. 4d. per mile per watering season.

Mr. H. C. Coales, the Borough Engineer of Market Harborough, outlined a scheme for dealing with town refuse in a remunerative manner by converting it into fuel briquettes and burning it in works' boilers or other grates without the construction of special furnaces. He pointed out that a dust manipulator was now on the market which pulverized refuse; and he estimated that by the incorporation of about 18 gallons of tar to the ton, the powdered refuse could be deodorized, agglutinated, and enriched by one operation. This proportion of tar did not allow of its escape through the grate-bars when subjected to the heat of the fire, nor to give off smoke from the chimney-shaft in consequence of incomplete combustion. He suggested that, roughly speaking, coalesine fuel would have an average calorific value of one-third that of best coal.

Mr. Walker Smith (Barrow-in-Furness) said the question of fuel depended on the procuring of tar at a reasonable price. Mr. Brown had pointed out that if all the roads were tarred, there would be just about enough to go round. If house refuse was going to be converted into fuel, he calculated that it would require three times as much tar as was produced in the United Kingdom, and there would be competition for tar for street work as against fuel.

WATER-WORKS PURCHASE AT STOURBRIDGE.

Shareholders Agree to the Transfer.

A Special Meeting of the Shareholders in the Stourbridge Water-Works Company was held last week for the purpose of confirming the action of the Directors when the Company's Provisional Order Confirmation Bill for an increase of capital was before the House of Lords recently. The Order was opposed by the combined Councils of Stourbridge, Lye and Wallescote, Amblecote, Kingswinford, and Bromsgrove; but an arrangement was come to whereby the Company consented to a clause being inserted in the Bill enabling a Joint Board of the Councils interested to acquire the undertaking upon certain terms for compensating officials and securing upon 3½ per cent. bonds the present income received by the shareholders. Mr. W. B. Collis, who presided, explained the arrangement come to; and the resolutions assenting to the proposals were then carried unanimously.

The clause inserted in the Order provides that if the Stourbridge Urban District Council or any two of the Councils mentioned shall introduce a Bill in the next session of Parliament to provide for the constitution of a Water Board to purchase the undertaking, the Company will not oppose the Bill except in so far as may be necessary to secure the insertion therein of clauses to protect their interests. The Water Board shall give notice of their intention to purchase within six months after the passing of the Act; and thereupon the Company shall sell the undertaking subject to all their then existing debentures, mortgages, obligations, and liabilities. The second paragraph of the clause states that the consideration for the purchase of the undertaking shall be such an amount of 3½ per cent. stock of the Water Board, redeemable in fifty years, as would yield to the shareholders the maximum dividends to which they are now entitled, and an additional amount of £2000 of the like stock as compensation to the Directors and others. The stock is to be secured on the revenue of the undertaking; and any deficiency of revenue is to be made good out of the rates of the districts constituting the Water Board.

It is anticipated that some £110,000 worth of bonds will be created by way of purchase and compensation, and that on the present income and expenditure of the water-works there is nearly sufficient margin to meet the increased obligations which the Joint Councils will have to pay to carry out the terms of their agreement and also to provide the sinking fund from which the bonds will ultimately be redeemed.

TEIGNMOUTH WATER SUPPLY.

Inauguration of the New Scheme.

After many years of anxious deliberation, the inhabitants of Teignmouth witnessed on Wednesday last the inauguration of an improved water supply. The subject has been under consideration at intervals ever since the year 1880. Innumerable schemes have been put forward, discussed, and rejected—some on account of the cost, others because they did not appear likely to provide a supply which was at once pure and abundant. A solution of the difficulty was found when the Paignton District Council decided to obtain a new supply for the town from Dartmoor, and offered to take as customers any of its neighbours who required water. This offer was closed with by the Teignmouth and Brixham Urban Councils, as well as by the authorities of some of the villages in the vicinity. In regard to the supply of Teignmouth, it has been necessary to lay about 10½ miles of 9-inch mains from the point of connection with the Paignton main at Ipplepen to the service reservoirs in the vicinity of Teignmouth. Two 9-inch Venturi meters have been fixed at Ipplepen, and the main is continued thence along the public road, and across the tidal estuary of the River Teign. At the point selected for the crossing of the river, it is about 460 yards wide. The main was here laid in duplicate, and involved some rather intricate work, owing to the necessity of laying the pipes 8 feet below the low-water line of the channel, so as not to cause any risk of interference with the navigation or dredging operations. A special flange pipe was provided for this portion of the work, and the whole length was encased in concrete. The original estimate of the cost of the scheme was £23,600; but this was reduced to £19,300 by the substitution of Mannesmann steel tubes for iron pipes. Messrs. R. C. Brebner and Co., of Edinburgh, were the Contractors for the work, which was carried out under the supervision of Mr. C. F. Gettings, the Surveyor to the District Council, who prepared the plans.

The ceremony of turning on the water was performed by Lord Clifford of Chudleigh, and took place at the Hazeldown service reservoir. A silver tazza was presented to his Lordship by Mr. R. C. Brebner, as a memento of the occasion; and Mr. Hethey, the Manager of the British Mannesmann Tube Company, presented a silver cup to Mr. F. Slocombe, the Chairman of the District Council. Various toasts were drunk in the water. At a luncheon afterwards, Mr. Slocombe narrated the history of the efforts to obtain a supply of water, and said that the matter was first brought before the late Local Board by himself in the year 1880. In the negotiations with Paignton, they had been treated in a thoroughly businesslike manner. Dr. Piggott, the Medical Officer of Health, said that the day was the most important in the history of the town; for they were now in possession of an ample supply of water, the purity of which would bear comparison with that of any town in the kingdom. Mr. W. J. Ham, Chairman of the Paignton District Council, expressed the hope that the arrangement between Paignton and Teignmouth would continue to the advantage of both towns. In Paignton they had incurred a very heavy expenditure on the water-works; but by supplying Teignmouth and Brixham they hoped to reduce the rates to the normal amount.

NOTES FROM SCOTLAND.

From Our Own Correspondent. *Saturday.*

The meeting of the North British Association in Edinburgh this week has, through its unfortunate clashing with the parliamentary inquiry into the Provisional Order of the Edinburgh and Leith Gas Commissioners, not received the undivided attention which I should like to have given to it. To the members of the Association the holding of the inquiry at the same time was a great boon; for they were able to hear the opinions of master minds upon a subject which greatly concerns them all, in a manner such as there are few like opportunities in a lifetime. Several of them availed themselves of the opportunity, and went away delighted with their good fortune. The meeting, presided over by Mr. William Blair, of Helensburgh, was well attended. Its *personnel* was sufficient to attract notice. The distinguished band of managers who used to preside over the deliberations of the Association some twenty years ago, have all but disappeared; nearly every one having been called to his rest. It is a reflection not out of place here that within the past few years the gas managers of Glasgow, Edinburgh, Dundee, Aberdeen, Perth, Greenock, Arbroath, Montrose, and Inverness have all been removed—all of them by the hand of death, with the exception of Mr. T. Whimster, of Perth, who is, happily, still spared to us. Only two of what may be called the old army corps were present at the meeting—Mr. A. MacPherson, of Kirkcaldy, and Mr. T. Wilson, of Coatbridge; and neither of them took any part in the proceedings. The feeling that a new order of things has arisen was probably accentuated by the fact that since the meeting last year the venerable Secretary of the Association—Mr. R. S. Carlow—has been removed; and thus the connecting-link with the past was more visibly severed. At all events, it was a sea of more juvenile faces than usual which confronted the President on Thursday; and the atmosphere which was breathed conveyed to at least one who has himself attended the meetings of the Association for a good many years now, the unmistakable sense of a new order of things having arisen. If the men of the former days kept the top spinning merrily from year to year, their successors are no less zealous

in devotion to their duties as publicists. Two subjects were introduced to the meeting which, if not so striking as would have been a communication upon an entirely new process, such as a setting of vertical retorts, are certain to receive attention as wide as, and will probably result in benefit more universal than, the larger subject would. These were contained in the papers by Mr. J. D. Keillor, of Lochgelly, and Mr. A. Waddell, of Dunfermline. Mr. Keillor is the first in Scotland to distribute gas under high pressure in the town he serves. He delighted his fellow-members with his description of the plant he employs, and its working. Pleased to learn of the success of Mr. Keillor's scheme, both practically and financially, members will be set thinking as to how they would fare in the event of their endeavouring to carry their gas into districts which hitherto they have been quite unable profitably to supply. Lighting possibilities in outlying districts have thus been advanced; and gas companies in many towns, who would willingly do more business if they could get it, will now be able to extend their borders, and in this way take a new lease of life. Mr. Waddell's communication was a contribution on the same subject, but with the most striking difference that he put forward an appliance by which the distribution of gas at high pressure will be facilitated and cheapened. This is not the first nor the second time that Mr. Waddell, by his inventive genius, has brought benefit to the gas industry. By this latest production of his, he makes the want of pressure at the far end of the main turn on more pressure at the works. The other paper, by Mr. R. Cowie, of Lockerbie, consisted of an account of the troubles and difficulties which have beset the gas undertaking at Lockerbie during the past seventeen years—that is, since it was taken over by the Corporation. The statement was a record of work well done. There are few places in which the gas undertaking has been in so parlous a condition as the one in Lockerbie. This condition is now, happily, a thing of the past; and much of the credit of restoring it to a state of prosperity is due to Mr. Cowie. The President's address was short and plain, as all Mr. Blair's utterances are. Before concluding, I wish to record that the new Secretary and Treasurer—Mr. L. Hislop, of Uddingston—makes a most capable official, as everyone expected he would.

Of greatest importance among the items upon which I may comment this week is the parliamentary inquiry which is proceeding in Edinburgh into the Provisional Order of the Edinburgh and Leith Gas Commissioners. Considering that only one point in the Order has been attacked—that of the illuminating power of the gas to be supplied—the inquiry has turned out to be much more protracted than could have been anticipated. Already three days have been consumed over the hearing of it, and it stands adjourned till Monday for the hearing of Counsel and the decision of the Commissioners. The Gas Commissioners, resolved not to allow the attainment of their object to be frustrated by any mischance, appeared before the tribunal with an array of expert witnesses which threw dismay into the bosoms of the opposing party. Besides their own Engineer—Mr. W. R. Herring—they had secured the services of Professor Vivian B. Lewes, Mr. Corbet Woodall, Mr. John F. Simmance, Mr. A. Wilson, of Glasgow, and Mr. F. T. Cotton, of Dublin—the last-named of whom was not examined. On the other side, the experts were: Mr. Isaac Carr, of Widnes, Mr. J. G. Newbigging, of Manchester, and Mr. Henry O'Connor, of Edinburgh. Like the promoters, the opposition did not call their last expert witness. It was somewhat amazing to see such a gladiatorial array over a question which, after all, has very little concern for any other communities than those of Edinburgh and Leith. Parliament has already granted power to the larger corporations in Scotland to come down in the illuminating power of the gas they supply to 16 candles, and in some instances to 15 candles; and the conflict in progress is therefore, so far as it is of general application, only over the question of a reduction of 1-candle power. To the citizens of Edinburgh and Leith it is of more consequence. A reduction of 6 candles is a big step to take; and if it were taken all at once, there can be no doubt that inconvenience and loss would ensue to many consumers. But the Gas Commissioners have given the assurance that they do not propose to come down to the full extent asked; and their assurance has been accepted by all except a few. If this few were possessed of reflective power, and exercised it, it should not require a long process of reasoning for them to convince themselves that the Commissioners are not likely to do anything which would cripple their own business. That is what would certainly follow any change they might introduce if it were counter to the interests of the consumers. It is very probable that there would have been no contest at present but for the unfortunate ruling of the Town Clerk of Edinburgh that the Commissioners are bound to supply gas of the prescribed standard at the place where it is consumed. Parliament has never said so, but, on the contrary, has enacted that the test of the gas shall be the article at the point of supply, which is the gasholder; and the Law Courts have invariably taken this view. As gasholders are mostly situated in gas-works, testing-stations are practically universally at the gas-works. There is a notable exception to this in the case of London, where there are numerous testing-stations within the area of supply. This has been fastened upon by the opponents of the Order, who are claiming a testing-station in the centre of the city. That the conditions existing in London are altogether different from those prevailing in Edinburgh was explained by Professor Lewes, perhaps not so fully to the lay minds of the Parliamentary Commissioners as it might have been. He stated that the gas in London was derived from a number of works, and that the testing-stations were at the inlets to the districts. The full significance of this is that sometimes gas from one works and sometimes from another, or, it may be, a mixture from more than one works, will be sent into a district for consumption. In such case, the gas is in reality delivered in bulk at the inlet to the district, which becomes the point of supply; and a test there is imperative. There is no delivery in bulk in Edinburgh; but there is a condition which is almost analogous, in the gasholders in the city, in which, it is admitted, gas is stored, and may lie for a day before being consumed. Had the opposition put forward a claim that there should be a testing-station at each of the gasholder stations, they would have had a stronger case than they have in the position that all gas from Granton should be tested at the City Chambers. Their case leaves out the part which is most favourable to them, because the City Chambers are supplied with gas from the direct main; and thus, if they should get their way, the result would be that consumers using gas from the direct Granton main would be protected, while those supplied from the holders in the city would not. Thus the proposals of the opposition are only one-sided, and not protective of the general body of the consumers. As I have remarked, the Town Clerk's mistake in law is responsible for the opposition. Before these "Notes" are published, the decision of the Parliamentary Commission will be given, and consequently further comment upon the proceedings may be held over till next week.

The Motherwell Gas Company have paid a dividend of 7½ per cent., and have resolved not to make any change in the price of gas, which is at present 2s. 11d. per 1000 cubic feet.

The Tayport Gas Company, Limited, have paid a dividend of 6¼ per cent., and have reduced the price of gas by 2½d.; making it 4s. 4½d. per 1000 cubic feet.

At the annual meeting of the Annan Gas Company, Limited, the Directors' report submitted was to the effect that the revenue for the year was £3626, and the expenditure £2747; leaving a surplus of £859. The disposable balance was £1048. Out of this the Directors proposed the payment of a dividend of 7 per cent. free of income-tax, that £200 be added to the contingent and insurance fund, and that a balance of £218 be carried forward. The gas made during the year amounted to 17,813,400 cubic feet—an increase of 364,000 cubic feet over the make of the previous year. The Chairman (Mr. T. H. Foster, of Longmeadow), in moving the adoption of the report, said there was one item which had become profitable to the Company, and was very creditable to their Manager—namely, the reduction in the leakage, which stood for the year at 3·17 per cent.—a saving of fully ½ per cent., equal to 88,000 cubic feet of gas. This was excellent, for, if they consulted the returns of other companies, they would find 5, 6, and 7 per cent. of loss very general. This proved conclusively that their plant and pipes were in good condition. During the year coal cost them, on an average, 15s. 6d. per ton, compared with 13s. 6½d. the previous year; but during the week preceding the meeting, the Directors had contracted for 18,000 tons at a reduced price, which made a good beginning for this year. It might interest them to know that any increase in the Company's dividend had always been followed by a reduction in the price of gas. From October, 1900, to October, 1902, the price was 4s. per 1000 cubic feet; during the following two years, a reduction was made to 3s. 6d.; in 1905, the price was 3s. 4d.; and since then it had been 3s. 2d. After Oct. 1 the price would be 3s. per 1000 cubic feet—a price never before charged by the Company, and unequalled in Scotland, if they considered the situation of the town and the population. During these years of reduction, the dividend, which in 1900 was 4 per cent., had risen to 6 per cent.; and if they adopted their report, they would next day pay them 7 per cent. The report was unanimously adopted.

A suggestive report is published regarding an explosion of gas at the mansion house of Mr. D. Davidson of Inchmores, in Aberdeenshire. An installation by which the house was lighted by means of petrol gas was recently introduced. On the evening of Friday of last week, an irregularity in the lighting was apparent, and Mr. Davidson went to the gas-house to investigate the cause. There he found the weights racing. From some unexplained cause an explosion occurred, which threw Mr. Davidson backwards seven or eight feet, against a wall. He was badly burned about the face, hands, and legs, and it is stated that his clothes were scorched almost to ribbons.

The Proper Employment of Gas Profits.

Under the heading of "Prices, not Profits," the "Municipal Journal" last Friday said: "We are glad to see that the Birmingham Gas Committee have taken a step towards the sound economic policy of reducing charges instead of devoting enormous profits to rate relief. Anticipating a saving in the coal contracts this year of £25,000, the Committee recommend the lowering of charges to small consumers by 2d. per 1000 cubic feet, which is equivalent to knocking nearly 7 per cent., or 1s. 4d. in the pound, off the gas bill of the ordinary householder. It is still estimated that a profit of £50,000 will be available for rate relief as the result of the year's operations; and we hope that if the price of coal increases again, the extra cost will be taken out of this accumulation, and that the charges for gas will not be raised to provide it. The gas consumers are already paying in gas profits an extra rate of 2d. in the pound which non-users of gas are not called upon to pay; and if the Corporation desire to pursue a sound civic policy, they will decrease this 'preferential' burden, and spread the city's rates equitably over all classes of the community."

Brussels Municipal Gas Supply.—The quantity of gas supplied in Brussels in the twelve months ending Dec. 31 last was rather more than 1366 million cubic feet, or at the rate of 7100 cubic feet per inhabitant. At the end of the year there were in use 42,079 meters, 15,537 interior installations of gas, 27,626 heating-stoves, and 418 gas-engines. The total expenditure was 5,150,771 frs. (£206,031), and the revenue was 7,336,904 frs. (£293,476); showing a balance of 2,186,133 frs. (£87,445). The quantity of coal carbonized was 114,740 tons; and 5239 tons of oil were employed for enrichment.

The Standard Oil Company's Fine.—About a year ago, we recorded that the Standard Oil Company had incurred a fine of $29,240,000 in respect of certain transactions with the Chicago and Alton Railroad Company. The Company took the matter to the Court of Appeal in Chicago, who have unanimously ordered a new trial on the threefold ground that the Judge who tried the case was wrong in declaring that the Standard Oil Company of Indiana should have ascertained whether the rates tendered by the Railway Company were those lawfully published, in reckoning the number of offences by the cartloads of oil transported, and in basing the fine on the wealth of the parent Company instead of on the capital of the legal defendant, the Indiana Company. The unanimity of the decision and its terms have created a strong impression that when the case reaches the United States Supreme Court this tribunal will sustain the opinion of the Court of Appeal.

CURRENT SALES OF GAS PRODUCTS.

Sulphate of Ammonia.

LIVERPOOL, *July* 25.

Quietness has again prevailed all through the week, and prices have barely been maintained, orders being for the most part for retail quantities only. The closing quotations are, consequently, £11 per ton f.o.b. Hull, £11 to £11 1s. 3d. per ton f.o.b. Liverpool, and £11 2s. 6d. per ton f.o.b. Leith. Interest in the forward position is sustained; but the ideas of makers and buyers are so divergent that very little first-hand business has resulted, and that only for near months.

Nitrate of Soda.

This article remains quiet in all positions; and the spot quotations are 10s. and 10s. 3d. per cwt. for 95 per cent. and refined qualities respectively.

Tar Products.

LONDON, *July* 27.

The markets are in almost every case unchanged. Pitch keeps very weak, especially for delivery this year, though there are a few inquiries for delivery early next year. Creosote is unaltered, with a fair demand. Benzol is perhaps weaker for prompt delivery. Toluol and 50-90 per cent. benzol are without interest. In solvent and heavy naphtha, business can only be effected at very low figures. Carbolic acid is weak, and no business is reported. Naphthalene and salts are firm.

The average values during the week were: Tar, 11s. 6d. to 15s. 6d., *ex* works. Pitch, London, 18s. 6d. to 19s.; east coast, 17s. 6d. to 18s.; west coast, 17s. to 18s., f.a.s. Benzol, 90 per cent., casks included, London, 7¼d. to 7⅜d.; North, 7d. to 7¼d.; 50-90 per cent., casks included, London, 7½d.; North, 7d. Toluol, casks included, London, 7⅜d. to 8d.; North, 7¼d. to 7½d. Crude naphtha, in bulk, London, 3¼d. to 3½d.; North, 3d. to 3⅓d.; solvent naphtha, casks included, London, 10d. to 10⅓d.; North, 9d. to 9⅓d.; heavy naphtha, casks included, London, 9⅔d. to 10⅓d.; North, 8⅔d. to 9⅓d. Creosote, in bulk, London, 2½d. to 2⅝d.; North, 2d. to 2⅛d. Heavy oils, in bulk, 2⅞d. Carbolic acid, 60 per cent., casks included, east coast, 1s. 5d. to 1s. 5⅛d.; west coast, 1s. 4⅜d. to 1s. 5d. Naphthalene, £4 10s. to £8 10s.; salts, 35s., packages included and f.o.b. Anthracene, "A" quality, 1⅛d. to 1½d. per unit, packages included and delivered.

Sulphate of Ammonia.

This article is quiet, and prices are practically unchanged. The principal Gas Companies quote £11 8s. 9d to £11 10s. Ordinary London makes on Beckton terms are £11. In Hull, the price is £11 to £11 1s. 3d.; in Liverpool, £11 1s. 3d. to £11 2s. 6d.; and in Leith, £11 3s. 9d.

Power Gas Corporation Limited and Reduced.—Last Tuesday, Mr. Justice Swinfen Eady sanctioned the petition of this Company, in support of which Mr. Hamilton, K.C., appeared, for the reduction of the capital from £350,000 to £300,000. As originally registered, the capital consisted of 250,000 ordinary shares of £1 each, and 100,000 deferred shares of like nominal value. In future there will be 250,000 ordinary £1 shares, and 100,000 deferred shares of 10s. each.

COAL TRADE REPORTS.

Lancashire Coal Trade.

The depression in the iron and cotton trades has reduced the demand for engine and boiler fuel considerably, with a still greater falling off in the requirements of householders. The holidays among the operative sections of the county also tend to decrease coal consumption. Colliery proprietors, however, show no signs of making any abatement in prices beyond the recent reduction of 10d. per ton for all kinds of house fuel. Their stocks are practically depleted; many of the pit hands are not on full time; and there is little hope of any further easement in prices for some period yet—rather are prospects on the side of dearer coal. In South Wales, the prices of fuel have been advanced. Less coal is being shipped to Ireland, Manxland, and some of the English ports. Coal for gas making is in fair summer request. The quotations at the Lancashire pits are: Best house coal 14s. 6d. to 15s. 8d., secondary 13s. 2d. to 14s., common 11s. 2d. to 12s. 8d., burgy 10s. 6d. to 11s. 4d., best slack 9s. to 10s., medium 8s. 6d. to 8s. 10d., lower qualities 7s. 9d. to 8s. 4d., coal for shipping 13s. to 14s., f.o.t. at the tips.

Northern Coal Trade.

There has been a greater animation in the northern coal trade, both for home and foreign use. The steam coal trade is very active; and the price of best Northumbrian steams varies from about 14s. 3d. to 14s. 6d. per ton for prompt delivery, with rather lower quotations for forward. Second-class steams are 12s. to 12s. 6d. per ton, and steam smalls from about 6s. to 7s. The production is now very heavy, but it is well taken up; and generally the remark applies to other kinds of fuel. In the gas-coal trade, the consumption is now increasing, though only slowly at first. Durham gas coals are being quoted from about 10s. 6d. to 11s. 3d. per ton f.o.b. for the usual qualities, with 11s. 6d. to 12s. for Wear special kinds. As to contracts, there are fewer in the markets, and the quantities are only limited. Many of the chief collieries have, however, sold forward the bulk of their output; and thus the prices are firmer in such cases. The small contracts that are noticed are at figures somewhat similar to those that are current—the rates that are above quoted. Coke is steady for export, and gas coke maintains its price; the production being still low. Good gas coke is from 15s. to 15s. 6d. per ton f.o.b.

Scotch Coal Trade.

The coal market was in abeyance last week, on account of the holidays in the west of Scotland, so no quotations are available. The exports reported for the week were 320,546 tons—an increase of 11,339 tons upon the previous week, and of 140,032 tons upon the corresponding week of last year. For the year to date, the total shipments have been 7,570,223 tons—a decrease of 292,176 tons upon the corresponding period of 1907.

Gas-Coal Market.

Under this heading, the "Financial Times" on Thursday last contained the following remarks: "The gas-coal season is finishing up much better for the colliery companies than at one time seemed likely. Notwithstanding a steadily weakening market, the producers have, right through the negotiations, consistently shown a firm front; and

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 225.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
590,000	10	Apl. 10	10	Alliance & Dublin 10 p.c.	19—20	..	5 0 0
268,324	10	,,	7	Do. 7 p.c.	13—14	..	5 0 0
310,000	Stk.	July 15	4	Do. 4 p.c. Deb.	99—102*	..	3 18 5
200,000	5	May 29	6¼	Bombay, Ltd.	6—6¼	..	5 0 0
40,000	5	,,	6½	Do. New, £4 paid	4⅛—4⅜	..	5 9 6
50,000	10	Feb. 27	14	Bourne-mouth Gas and Water — 10 p.c.	28½—29½	+½	4 14 11
51,810	10	,,	7	B 7 p.c.	16½—16⅝	..	4 3 7
53,200	10	,,	6	Pref. 6 p.c.	14⅜—15⅜	..	3 17 5
380,000	Stk.	,,	12½	Brentford Consolidated	242—247	..	5 1 3
300,000	,,	,,	9⅜	Do. New	180—185	..	5 2 8
50,000	,,	,,	5	Do. 5 p.c. Pref.	120—125	..	4 0 0
206,250	,,	June 12	4	Do. 4 p.c. Deb.	100—105	..	3 16 2
220,000	Stk.	Mch. 12	11½	Brighton & Hove Orig.	208—213	..	5 5 5
246,320	,,	,,	8½	Do. A. Ord. Stk.	152—157	..	5 5 1
460,000	20	Mch. 27	10	British	41—43	—½	4 13 0
104,000	Stk.	Feb. 13	6	Bromley, Ord. 5 p.c.	116—119	..	5 0 10
165,700	,,	,,	4½	Do. do. 3½ p.c.	86—89	..	5 1 2
500,000	10	May 14	7	Buenos Ayres (New) Ltd.	11—11⅛	..	6 1 9
250,000	Stk.	June 26	4	Do. 4 p.c. Deb.	91—93	..	4 6 0
150,000	20	July 15	7½	Cagliari, Ltd.	24—25*	..	5 16 0
100,000	10	—	—	Cape Town & Dis., Ltd.	4—6	..	—
100,000	10	Apl. 26	4½	Do. 4½ p.c Pref.	5—7	..	6 8 7
50,000	50	May 2	6	Do. 6 p.c. 1st Mort.	47—49	+1	6 2 5
100,000	Stk.	June 26	4½	Do. 4½ p.c. Deb. Stk.	78—83	—2	5 8 5
157,150	Stk.	Feb. 27	5	Chester 5 p.c. Ord.	111—113	..	4 8 6
1,493,280	Stk.	Mch. 12	5⅜	Commercial 4 p.c Stk.	106—111	..	4 13 8
560,000	,,	,,	5	Do. 3½ p.c. do.	101—106	..	4 14 4
475,000	,,	June 26	3	Do. 3 p.c. Deb. Stk.	81—83	..	3 12 3
800,000	Stk.	June 12	6½	Continental Union, Ltd.	110—115	—2	5 13 1
200,000	,,	,,	7	Do. 7 p.c. Pref.	136—141	..	4 19 3
460,170	Stk.	—	5½	Derby Con. Stk.	121—123	..	4 9 5
55,000	,,	—	4	Do. Deb. Stk.	103—105	..	3 16 2
148,935	,,	Mch. 31	5	East Hull 5 p.c. Ord.	100—103	..	4 17 1
486,090	10	July 15	12	European, Ltd.	22½—23½*	..	5 2 2
354,060	10	,,	12	Do. £7 10s. paid	16—17*	..	5 5 10
15,182,590	Stk.	Feb. 13	4/10/8†	Gas-light and Coke — 4 p.c. Ord.	98⅝—99½	+1	4 11 2
2,600,000	,,	,,	3½	3½ p.c. max.	87—90	..	3 17 9
3,799,735	,,	,,	4	4 p.c. Con. Pref.	106—109	..	3 13 5
4,193,975	,,	June 12	3	3 p.c. Con. Deb.	83—85	..	3 10 7
258,740	Stk.	Mch. 12	5	Hastings & St. L. 3½ p.c.	93—93	..	5 2 0
82,500	,,	,,	6½	Do. do. 5 p.c.	112—115	..	5 13 1
70,000	10	Apl. 29	11	Hongkong & China, Ltd.	18—19	..	5 15 9
4,940,000	Stk.	May 14	8	Imperial Continental	179—182	—1	4 7 11
473,600	Stk.	Feb. 13	3½	Do. 3½ p.c. Deb. Red.	95—97	..	3 12 2
195,242	Stk.	Mch. 12	6	Lea Bridge Ord. 5 p.c.	113—118	..	5 1 8
561,000	Stk.	Feb. 27	10	Liverpool United A	232—234	..	4 5 6
718,100	,,	,,	7	Do. B	165—167	..	4 3 10
306,083	,,	June 26	4	Do. Deb. Stk.	104—106	..	3 15 6
152,736	Stk.	Feb. 13	7⅜	Maidstone 5 p.c.	136—141	..	5 8 2
75,000	5	June 26	6	Malta & Medn., Ltd.	4¼—4⅜	..	6 6 4
560,000	100	Apl. 1	5	Met. of — 5 p.c. Deb.	101—103	..	4 17 1
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	101—103	..	4 7 5
541,920	20	May 29	3½	Monte Video, Ltd.	11—12	..	5 16 8
1,775,892	Stk.	Feb. 27	4⅝	Newc'tle & G'tesh'd Con.	108—109	..	4 4 10
418,460	Stk.	June 26	3½	Do. 3½ p.c. Deb.	90—92	+½	3 16 1
15,000	10	Feb. 27	10	North Middlesex 10 p.c.	20—21	..	4 15 3
55,940	10	,,	7	Do. 7 p.c.	13½—14½	..	4 16 7
300,000	Stk.	Apl. 29	8	Oriental, Ltd.	140—143	..	5 11 11
60,000	5	Mch. 27	7	Ottoman, Ltd.	6—6½	..	5 7 8
398,490	5	Apl. 29	7	Primitiva Ord.	6—6½	..	5 7 8
796,980	5	Jan. 30	5	Do. 5 p.c. Pref.	5—5⅛	..	4 15 3
488,900	100	June 1	4	Do. 4 p.c. Deb.	92—94	+1	4 5 1
1,000,000	10	Apl. 29	8	River Plate Ord.	13½—13⅝	..	5 16 5
312,650	Stk.	June 26	4	Do. 4 p.c. Deb.	91—93	..	4 6 0
250,000	10	Apl. 10	8	San Paulo, Ltd.	13⅜—14	..	5 14 4
125,000	50	July 1	5	Do. 5 p.c. Deb.	49—51	..	4 18 0
135,000	Stk.	Mch. 12	10	Sheffield A	245—246	..	4 1 4
209,984	,,	,,	10	Do. B	244—246	..	4 1 4
523,500	,,	,,	10	Do. C	244—246	..	4 1 4
70,000	10	May 29	10	South African	13—14	..	7 2 10
6,429,895	Stk.	Feb. 13	5½	South Met., 4 p.c. Ord.	119—121	+1	4 8 1
1,895,445	,,	July 15	3	Do. 3 p.c. Deb.	83—85*	..	3 10 7
209,820	Stk	Mch. 12	8	South Shields Con. Stk.	155—157	..	5 1 11
605,000	Stk.	Feb. 27	5⅜	S'th Suburb'n Ord. 5 p.c.	116—119	..	4 9 7
60,000	,,	,,	5	Do. 5 p.c. Pref.	120—125	..	4 0 0
117,058	,,	July 15	5	Do. 5 p.c. Deb. Stk.	120—125*	..	4 0 0
502,310	Stk.	May 14	5	Southampton Ord.	105—110	..	4 10 11
120,000	Stk.	Feb. 27	6⅞	Tottenham — A 5 p.c.	120—125	..	5 8 0
398,940	,,	,,	5¼	and — B 3½ p.c.	107—109	..	4 16 4
149,470	,,	June 26	4	Edmonton — 4 p.c. Deb.	98—103	..	3 17 8
182,380	10	June 12	8	Tuscan, Ltd.	10—10⅛	..	7 12 4
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	97—99	..	5 1 0
193,742	Stk.	Feb. 27	5	Tynemouth 5 p.c. max.	106—107	..	4 13 6
255,636	Stk.	Feb. 13	6½	Wandsworth — B 3½ p.c.	128—133	..	4 17 9
80,075	,,	June 26	3	and Putney — 3 p.c. Deb. Stk.	72—77	..	3 17 11
845,872	,,	Feb. 27	5½	West Ham 5 p.c. Ord.	100—102	..	5 0 6
185,000	,,	,,	5	Do. 5 p.c. Pref.	120—125	..	4 0 0
228,300	,,	June 26	4	Do. 4 p.c. Deb. Stk.	100—105	..	3 16 2

Prices marked * are "Ex div." † Next dividend will be at this rate.

though there is much business yet to place, the gas companies are finding themselves compelled to give combination prices. Since the combined colliery owners decided to stand out for a basis price showing a reduction of only 6d. per ton on the figures ruling a year ago, there has been no record of any best quality gas coal being bought at any lower price than this. But, on the other hand, there is no denying that fortunately placed gas companies—fortunately placed, that is, in having low freights from the pits—have taken an unusually large quantity of lower grade fuel at a very substantial reduction on the proportionate prices they were compelled to give a year ago. We may take the case of Birmingham, where the average saving ranges between 9d. and 1s. per ton. At Nottingham a large saving has also been effected; and the same may be said of Salford. But at Manchester the saving is only about 6d. per ton. Many small concerns in the Midlands have reason to congratulate themselves on the good bargains they have made, for they have bought extensively at up to 1s. 6d. per ton reduction. Everything, of course, depends on the quality of the fuel bought. The most favourable terms (for the consumers) secured apply to second-grade coals. The available supply of the best grade is to some degree limited, and gas-works at a distance, in deciding on the quality they will use, have to take into consideration not only the gas and coke yield, but the carriage to their works, waggon hire, wear and tear of plant, &c.; for the best coal costs no more for carriage than the worst, and if a smaller quantity will yield equivalent results, it is obviously to the advantage of distant works to take as little as possible. The proprietors of gas-coal collieries, of course, are quite aware of this; hence the firm stand made for the stipulated price. In fact, in view of coming legislation affecting coal-mining, many gas-works in the South have expressed a willingness to contract for three years. This is the case with Ramsgate; tenders for 25,000 tons having been submitted from the North-East Coast for one year, with an understanding that, if prices were in any way suitable, business for three years might be done."

Portrush Water Supply.—An inquiry has been held at Portrush, by Mr. P. C. Cowan, of the Local Government Board, with reference to an application by the Urban District Council for sanction to a loan of £6000 for extending the water-works. The Engineer, Mr. J. H. H. Swiney, explained that the works would consist of two wells, a new 18 million gallon reservoir, additional filters, &c. There was no opposition to the granting of the loan.

Fused Electric Wires in Manchester.—Two small fires were caused in Manchester last Saturday week by the fusing of electric light wires. One was at the "Evening News" office, and the other at the Manchester County Bank. An unusually powerful current was being distributed to meet the heavy demand of the tramway car traffic and shop lighting; and the fusing of the wires set fire to the surrounding woodwork in the two offices. The promptitude of the fire brigade in dealing with the outbreaks, however, prevented any serious damage being done at either building.

Fatal Gas Poisoning Cases at Belfast.—A married woman named Maggie Townsend was found dead on her bed at her house in Belfast with the room full of gas; and the Coroner's Jury returned a verdict that death was accidental. In a second case a servant girl was found dead in bed with the gas turned on, but not lighted; and the Jury agreed that her death was due to gas poisoning owing to misadventure.

Croydon Water Supply.—The Corporation of Croydon and the riparian owners on the River Wandle have amicably settled certain differences which had arisen between them. It was feared that the flow of the river would be interfered with by the heavy pumping by the new machinery which the Corporation are about to introduce at their well and borehole; but the terms agreed upon are that the Corporation are not to raise at their works at Waddon more than 50 million gallons of water in every period of thirty days without obtaining the assent of Parliament. The Corporation will pay the costs; and the pumping limit is generally regarded as being fair for the continued prosperity of the district.

Proposed New Reservoir at Devonport.—Plans for the construction of the proposed new storage reservoir were submitted to a meeting of the Devonport Water Committee last week. This is part of the scheme which the Committee have already commenced for the improvement of the works. The proposed reservoir will have a capacity of 20 million gallons; and it is also intended to construct an additional filter-bed. It is estimated that the works will cost £31,000. The intention of the Water Committee is to begin the construction of the reservoir in October, and to carry it out by direct labour with the object of finding work for the unemployed during the winter months. In addition to the works already accomplished, which substituted pipes for a portion of the open leat, it is intended to improve the leat by facing the sides with masonry, so as to reduce the loss of water by leakage.

Brixham Water Supply.—The new water supply for Brixham was recently publicly inaugurated, when the water was turned on by Miss Layland-Barratt, daughter of the Member for the division. The supply is derived from the new works which have been constructed by the Paignton Urban District Council at Holne Moor, Dartmoor. Under the arrangement made between the Brixham and Paignton Councils, Brixham is to be supplied with a minimum of 75,000 gallons and a maximum of 200,000 gallons per day, at a cost of from 5d. to 6d. per 1000 gallons. The water will supply the highest levels of the district, which hitherto have been put to inconvenience because of the insufficiency of the supply. The local works include a service reservoir and the laying of a 7-inch main from the nearest point at which connection could be made with the Paignton trunk main. These works have cost between £6000 and £7000. Sir F. Layland-Barratt congratulated the people of Brixham on having succeeded in obtaining a supply of water without incurring the expense of promoting a Bill in Parliament. Paignton was also to be congratulated on the fact that it had water enough for its own requirements as well as to supply the needs of its neighbours.

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Suicide by Gas at Halifax.—William Suddaby, a joiner, committed suicide at Halifax last week by means of gas, while, it was stated, he was under the influence of drink. He was found lying with a pipe in his mouth which was connected to a gas-fitting, the gas from which was escaping.

New Joint-Stock Companies.—The Robin Gas-Mantle Works, Limited, has been registered with a capital of £10,000, in £1 shares, to carry on the business of manufacturers of, and dealers in, incandescent mantles and fittings of all kinds, gas engineers, &c. The Solid-Top Incandescent Mantle Company, Limited, with a capital of £3000, in £1 shares, is to acquire from H. Nobbs, A. Tapley, and J. G. Thomas the benefit of a certain existing invention for improvements in mantles for incandescent burners, and to carry on the business of manufacturers of, and dealers in, incandescent and other mantles, gas and other fittings, &c.

Birmingham and District Master Gas-Fitters' Association.—The income and expenditure account submitted at the fourth annual general meeting of the Association showed that there was a small balance of £10 odd in hand. The Chairman (Mr. John Thacker) stated that deputations had, with advantage to the members, been appointed to wait at various times upon the Secretary of the Gas Department, upon the City Surveyor, the Public Works Committee, the Tube Association, and the various tube manufacturers, on the vexed question of direct trading. They had been successful in obtaining from the Gas Department more work for the outside fitters, in connection with the fixing of gas-cookers at remunerative prices; concession had been obtained from the Public Works Department with respect to the restrictions on lettering outside lamps; and it was hoped to obtain from the tube houses an extra discount to the trade.

The inauguration of water-works for Alford (Lincolnshire) took place last Friday; the ceremony being performed by the Chairman of the North-East Lincolnshire Water Company. The pumping-station is situated near the Great Northern Railway Station. The reservoir is built upon a foundation of rock at the top of Mile's Hill, a mile distant, and has a capacity of 75,000 gallons.

The Oldham Corporation have placed the order with Messrs. Robert Dempster and Sons, Limited, of Elland, for four purifiers, 35 feet by 28 feet by 6 feet, on "Green's" system, with Green's patent leak-detector. The contract includes staging, superstructure, and roof; and the work has to be carried out to plans and specification prepared by Mr. T. Duxbury, the Corporation Gas Engineer.

The Looe Gas and Coke Company recently instructed the Richmond Gas Stove and Meter Company to undertake the further development of their district. An exhibition was consequently held and the town was thoroughly canvassed. As a result, a large number of gas-cookers have been placed out in the town, and nearly 100 complete automatic gas installations have been supplied and fitted by the firm.

The Manchester Corporation have placed with the Wholesale Fittings Company, Limited, their contract for the ensuing year for French hard glass protectors for street lighting. The glass in question is specially manufactured for the Company at Choisy-le-Roi, and is a very keen competitor of the best German make. While it is claimed to be equal in every respect to the German glass in quality, it is considerably cheaper in price.

Through the courtesy of the Baberton Golf Club, of Edinburgh, members of the North British Association of Gas Managers who had assembled in that city to attend the annual meeting of the Association were last Wednesday accorded the privilege of playing over the course of the club at Jumper Green. Twenty-two players started. The scratch prize was won by Mr. W. Peattie, of Dunblane; and the handicap prizes were tied for by Mr. J. Dickson, of Kelty, and Mr. J. Simpson, of Bellshill.

APPLICATIONS FOR LETTERS PATENT.

14,790.—Helps, G., "Gas-lamps." July 13.
14,835.—Podmore, A. E., and Thomas, J., "Inverted lamps." July 13.
14,855.—M'Culloch, J. M'G., "Rotary engines, pumps, blowers, or meters." July 13.
14,884.—Balfour, H., and Co., Ltd., Barker, J., and Hunter, J., "Spiral guides and gasholders." July 14.
14,885.—Glover, T., Wayte, W. H., and Hands, G., "Gas or air regulators." July 14.
14,930.—Hurst, C., and Wood, R., "Gas-engines." July 14.
14,971.—Sabatier, P., "Manufacture of methane or of mixtures of methane and hydrogen." July 14.
14,979.—Raybould, A., and Seymour, A. E., "Gas pendants." July 15.
14,984.—Thorp, T., "Combined rotary blower and pressure regulator." July 15.
14,989.—Potter, W. G., "Burning carburetted air." July 15.
15,000.—Ridley, C., "Obtaining gases from solids." July 15.
15,042.—Lake, W. E., "Gas producers." A communication from E. N. Trump. July 15.
15,104.—Robeson, A. M., "Meters." July 16.
15,126.—Love, G. R., "Coal-charging shoot." July 16.
15,134.—Hoddle, C., and the Thorn and Hoddle Acetylene Company, Ltd., "Gas regulating cocks or valves" July 16.
15,143.—Helps, G., "Gas pendants and burners." July 17.
15,178.—Hanappe, E., "Gas generators." July 17.
15,186.—Stoneham, J. A., and F. A., "Coin-meters." July 17.
15,212.—Morton, F., "Folding gas-cooking attachments for kitcheners." July 18.
15,217.—Pullen, H., "Inverted burner." July 18.
15,263.—Boughton, H. F., and Cruickshank, A., "Gas-lights." July 18.

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CARRON, STIRLINGSHIRE.

A meeting of creditors of the English Gas-Mantle Company, Limited, was held last Wednesday, when a statement was presented which showed that the Company had a nominal capital of £50,000; the net capital issued being £26,302, and the debenture capital £16,885. There are some unissued shares. The creditors are: Trade, £931 18s. 1d.; bought ledger, £3210 13s. 11d.; and sundries, £1015 5s. 1d.—a total of £5157 17s. 1d.; the grand total being £48,395 17s. 1d. On the other hand, the freehold, plant, furniture, and fittings are estimated at £30,423 7s. 3d.; the preliminary expenditure account is £9624 11s. 2d.; the stock-in-trade, £4670 13s. 5d.; the stock of thorium, £1126 9s. 7d.; and debtors, including sales ledger, &c., £2426 4s. 11d. The cash at the bank (£124 10s. 9d.) brings the total to £48,395 17s. 1d. From this an apparently large dividend might be expected; but it was pointed out at the meeting that the major part of the assets consisted of ground and premises at Streatham, and that if there were a forced sale nothing like the figures put down might be realized. The appointment of Mr. W. L. Ellis as Liquidator was confirmed, with a Committee of Inspection.

"ILLUMINATING TRUTHS."

LEAFLETS FOR DISTRIBUTION.

No. 1.—"The Sanitary Aspects of Gas and Electric Lighting."
No. 2.—"The Cleanliness of Illuminants: The Eyesight."
No. 3.—"Fire Risks."
No. 4.—"The Relative Cost of Gas and Electricity, and Matters affecting it."
No. 5.—"On Reliability, with Instances of Misplaced Confidence."
No. 6.—"On Shop Lighting, with Special Reference to the Flame Arc Lamp."
No. 7.—"The Osram Lamp: Fiction and Fact."

This series of Leaflets will be useful, not only for distribution among Householders generally, but for circulation among Shareholders to fortify them with arguments in defence of the commodity in which they have invested capital. Copies of each Leaflet should also be kept in every Gas Undertaking's Show-Rooms.

Prices for Quantities on Application to WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

WANTED, FOR SALE, CONTRACT, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Situations Vacant.

ERECTION OF GAS-WORKS. No. 4970.

Situations Wanted.

CLERK OR CLERK AND COLLECTOR. Price, Denbigh.

Pupil Required. No. 4969.

Correspondence Classes. H. Lees, Hesham.

Plant, &c. (Second-Hand) Wanted.

WATER-GAS PLANT. "L 69," care of Lee and Nightingale's Advertising Offices, Liverpool.

Patents to Sell or Licences to Manufacture.

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"PIPE COUPLINGS." Lloyd Wise and Co., Lincoln's Inn Fields, W.C.

Meetings.

BRENTFORD GAS COMPANY. St. Ermin's Hotel. Aug. 7. 2.30 o'clock.
COMMERCIAL GAS COMPANY. Cannon Street Hotel. Aug. 13. Twelve o'clock.
GASLIGHT AND COKE COMPANY. Chief Office. Aug. 7. Twelve o'clock.
SOUTH SUBURBAN GAS COMPANY. De Keyser's Hotel. Aug. 7. Three o'clock.

TENDERS FOR

Coal and Cannel.

DALTON-IN-FURNESS URBAN DISTRICT COUNCIL. Tenders by Aug. 15.
MOSSLEY GAS DEPARTMENT. Tenders by Aug. 11.
NEWMARKET GAS COMPANY. Tenders by Aug. 4.
SOUTH SUBURBAN GAS COMPANY. De Keyser's Hotel. Aug. 7. Three o'clock.
WARRINGTON GAS DEPARTMENT. Tenders by Aug. 6.
WINSFORD URBAN DISTRICT COUNCIL. Tenders by Aug. 8.

Cookers.

WARRINGTON GAS DEPARTMENT. Tenders by Aug. 6.

Fire Clay Goods.

WARRINGTON GAS DEPARTMENT. Tenders by Aug. 6.

Gas-Works Reconstruction, &c.

ST. PETERSBURG MUNICIPAL COUNCIL.

General Stores (Benzol, Lime, Lead, Tubing, Lamps, Glass, Iron and Steel, Oil, Paints, Taps, Valves, &c., &c.)

WARRINGTON GAS COMMITTEE. Tenders by Aug. 6.
WINSFORD URBAN DISTRICT COUNCIL. Tenders by Aug. 8.

Meters.

DEWSBURY CORPORATION. Tenders by Aug. 10.
WARRINGTON GAS DEPARTMENT. Tenders by Aug. 6.

Oxide of Iron.

SALFORD GAS DEPARTMENT. Tenders by Aug. 13.

Pipes, &c.

DALTON-IN-FURNESS URBAN DISTRICT COUNCIL. Tenders by Aug. 15.
DEWSBURY CORPORATION. Tenders by Aug. 10.
WARRINGTON GAS DEPARTMENT. Tenders by Aug. 6.

Sulphuric Acid.

DEWSBURY CORPORATION. Tenders by Aug. 10.

Washer (Rotary).

BIRSTALL GAS DEPARTMENT. Tenders by Aug. 8.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

BANK HOLIDAY.

In consequence of the BANK HOLIDAY, Communications for the next issue of the "JOURNAL" and Orders respecting ADVERTISEMENTS should be received at the Office

NOT LATER than the FIRST POST ON SATURDAY.

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LUX'S GAS PURIFYING MASS See Advertisement on p. 278. Friedrich Lux, Ludwigshafen-am-Rhein.

BY adopting Cripps's Bye-Pass Valves inside your Purifiers, you can relieve the Back-Pressure in the Lower Tiers when the Purifying Material gets hard. They are extremely useful and economical.
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BROTHERTON & CO., LIMITED. Offices: City Chambers, Leeds. Correspondence invited.

TO Gas Managers, &c., Wanted, Old Condemned GAS-METERS, from 1-light to 1000-light, for destruction to re-claim Metals. Write for Prices, Stating Quantities and Sizes, and if Wets or Drys. Scrap Metals, Drosses, Metal Shop Sweepings, &c., also bought
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MEWBURN, ELLIS, & PRYOR, Chartered Patent Agents, 70 & 72, Chancery Lane, London, W.C. Telegrams: "Patent London." Telephone: No. 243 Holborn.

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SIMULTANEOUS Discharging-Charger. The one Machine which Discharges and Charges at One Stroke.
See Advertisement, July 21, p. III. of Centre.
ALDRIDGE AND RANKEN,
9, Victoria Street, Westminster, S.W.
Telegrams: "Motorpathy, London." Telephone: 5118 Westminster.

"VITERNUS" METALLIC PAINT FOR GAS-WORKS PLANT.
JOHN E. WILLIAMS AND CO.,
LOWER MOSS LANE,
MANCHESTER, S.W.
Telegrams: "Enamel." Nationa Telephone 1759.

GAS OILS.
MEADE-KING, ROBINSON, & CO. Represent the Strongest Independent Refineries in America; also Petroleum Spirit for Gas Enrichment. 18, Exchange Street, Manchester, and 11, Old Hall Street, Liverpool.

AMMONIACAL Liquor wanted. Chance and Hunt, Ltd., Chemical Manufacturers, Oldbury, Worcs.
Telegrams: "Chemicals."

GAS TAR wanted. Brotherton and Co., Ltd., Tar Distillers.
Works: Birmingham, Glasgow, Leeds, Liverpool, Wakefield, and Sunderland.

R. & G. HISLOP,
GAS ENGINEERS, RETORT BUILDERS, CONTRACTORS, &c.
RETORT SETTINGS, COAL-TESTING PLANT, BOILER FIRING.
Underwood House, PAISLEY.

SULPHATE OF AMMONIA SATURATORS and all LEAD and TIMBER WORK in Connection with Sulphate Plants.
We guarantee promptness, with efficiency for Repairs.
Joseph Taylor and Co., Central Plumbing Works, Bolton.
Telegrams: Saturators, Bolton. Telephone 0848.

AMMONIACAL Liquor wanted. Brotherton and Co., Ltd., Ammonia Distillers.
Works: Birmingham, Glasgow, Leeds, Liverpool, Wakefield, and Sunderland.

BRISTOL RECORDING GAUGES AND THERMOMETERS.
J. W. & C. J. PHILLIPS, 23, College Hill, London, E.C., and 7, Park Square, Leeds.

GAS PLANT for Sale—We can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
Firth Blakeley, Sons, and Company, Limited, Thornhill, Dewsbury.

PINCHBECK'S Meters and Burglar PROOF STRONG BOX.
See illustrated advertisement, July 21, p. I. of Centre.
Pinchbeck Limited, Adams Place, George's Road, Holloway, N.

THE British Bulk Creosote Company, Borough Road, Weaste, Manchester.

J. E. C. LORD, Ship Canal Tar Works, Weaste, Manchester. Pitch, Creosote, Benzols, Toluol, Naphtha, Pyridine, all kinds of Cresylic Acid, Carbolic Acid, Sulphate of Ammonia, &c.

TEACHING BY CORRESPONDENCE.
MR. HERBERT LEES is open to pre- pare Students, by Correspondence, for the "Gas Engineering" and "Gas Supply" Examinations of the City and Guilds of London Institute.
For Terms, &c., Apply to Elvaston Road, Hexham.

GENERAL Clerk, or Clerk and Collector, requires SITUATION in Gas or Water Office. Eight Years' Experience. Excellent Testimonials. Age 24.
Address, R. A. Price, Bronhaul, Denbigh.

WANTED, a thoroughly Reliable Gen- tlemanly Man, Single, under Thirty Years of Age, to Undertake ERECTION of a Small Gas-Works, and the necessary Fittings. Must be well Recommended. Gas Manager's Son would suit the Position if Experienced. The Man Selected would probably be required to go to India or Egypt for a Term.
Apply, by letter only, to No. 4970, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

PUPIL.
THE Engineer of a Large Gas-Works in the South of England has a Vacancy for a PUPIL. Premium required. Large Extensions and Alterations in Progress.
Apply, by letter only, to No. 4969, care of Mr. King, 11, Bolt Court, Fleet Street, E.C.

WANTED, a Small Second-Hand WATER-GAS PLANT Complete, Capable of making up to 100,000 Cubic Feet of Gas per Twenty-Four Hours.
Give full Particulars of the Plant, Dimensions, &c. All the burnt brickwork to be cleaned out. State where it can be seen, and cost, packed and marked for shipment f.o.b. Liverpool.
Offers to be sent to "L69," care of Lee and Nightingale's Advertising Offices, Liverpool.

WE have the following New and Over- hauled Second-Hand PLANT FOR SALE:—
Gasholders, 30 ft. by 12 ft. New Steel Tank.
" 35 ft. by 10 ft. Cast-Iron Tank.
" *45 ft. by 12 ft.
" *50 ft. by 16 ft.
" *50 ft. by 15 ft. 4 in. (Two-Lift)
*We Can re-erect these in Brick or New Steel Tanks.
8-inch, 9-inch and 10-inch Condensers.
New "Cripps" Washer (8-inch), 150,000, c.f. per day.
Walker's Purifying Machine.
Exhausters and Engines, Single and Combined, 2000 to 60,000 feet per hour.
Cast-Iron Tower Scrubber, 7 ft. diameter, 55 ft. high.
Purifiers, sets 6-fts., 10-fts., 12-fts., and 20-fts.
Plans and Quotations of new Sets.
6-inch to 18-inch Station Meters, Governors, &c.
Tar and Liquor Pumps.
Producer-Gas Plants for 150 to 300 H.P.
Boilers, Tanks, and all requisites for Gas-Works.
Firth Blakeley, Sons, and Company, Limited, Gas Engineers, Thornhill, Dewsbury (Yorks.).

BOROUGH OF MOSSLEY.
THE Gas Committee of the Borough of Mossley invite TENDERS for the Supply of GAS COAL.
Specifications and Forms of Tender may be obtained from the undersigned.
Sealed Tenders, endorsed "Gas Coal," and addressed to the Chairman of the Gas Committee, Gas-Works, Mossley, must be delivered not later than the First Post on Tuesday Morning, Aug. 11.
James Taylor,
Engineer and Manager.
Gas-Works, Mossley,
July 14, 1908.

COUNTY BOROUGH OF WARRINGTON.
THE Gas Committee invite Tenders for the undermentioned GOODS.
Full Particulars can be obtained on Application to Mr. W. S. Haddock, Gas Engineer, Warrington.
All Inquiries must be made before the 6th of August next.

1.—Bags.
2.—Bolts and Nuts.
3.—Brass and Copper Tubing.
4.—Brass Fittings.
5.—Builders' Ironmongery.
6.—Cast-Iron Pipes and Connections.
7.—Cement.
8.—Castings.
9.—Clothing.
10.—Copper Street Lamps.
11.—Cookers.
12.—Common, Paving, and other Bricks.
13.—Fire-Bricks, Fire-Clay, and Retorts.
14.—Flexible Tube.
15.—Glass.
16.—Iron and Steel.
17.—Lead and Compo. Pipe.
18.—Lime.
19.—Oils, Paint, &c.
20.—Printing and Stationery.
21.—Rails, Crossings, Fastens, &c.
22.—Red and White Lead.
23.—Setts.
24.—Timber.
25.—Wet and Dry Gas-Meters.
26.—Wrought-Iron Tubes and Fittings.
27.—Coal, Slack, or Nuts, 30,000 tons.
28.—Cannel, 6000 Tons.
29.—Benzol, 7000 Gallons.
30.—Taps, Valves, &c.

Fredk. Taylor,
Secretary.
Gas Offices, Warrington,
July 25, 1908.

COUNTY BOROUGH OF SALFORD.
(Gas Department.)
THE Gas Committee are prepared to receive TENDERS for the Supply of 1100 Tons of OXIDE OF IRON Purifying Material.
Full Particulars may be obtained on Application to Mr. Wm. W. Woodward, Engineer, Gas Offices, Bloom Street, Salford.
Sealed Tenders, endorsed "Tender for Oxide," to be delivered to me not later than Three p.m. on Thursday, the 13th day of August, 1908.
L. C. Evans,
Town Clerk.

URBAN DISTRICT COUNCIL OF BIRSTALL.
(Gas Department.)
THE above Council invite Tenders for the Supply and Erection, at their Gas-Works, of One ROTARY WASHER, capable of passing 200,000 to 250,000 Cubic Feet of Gas per Twenty-four Hours.
Full Particulars may be obtained from Mr. A. J. Jackson, the Council's Gas Manager.
Sealed Tenders, endorsed "Washer," to be delivered to the undersigned not later than the 8th day of August next.
By order,
Wm. Middlebrook,
Clerk to the Council.
Council Offices, Birstall,
near Leeds.

DALTON-IN-FURNESS URBAN DISTRICT COUNCIL.
ASKAM-IN-FURNESS GAS-WORKS.
THE Highways and Lighting Committee are prepared to receive TENDERS, not later than the 15th of August, 1908, for the Supply at their works of about 600 Tons of Best Screened GAS COAL, for a period of Twelve Months from the 1st of September, 1908.
Also Tenders for SPECIALS and on or about 355 Yards of 5-inch Cast-Iron Coated GAS-PIPES, delivered at the above Works.
W. Richardson,
Town Surveyor.
Town Hall, Dalton-in-Furness,
July 23, 1908.